GOVERNMENT OF ORISSA

NOTES ON SOME
OF THE
COMMONER TREES AND SHRUBS
FOUND IN
ORISSA

BY

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[*Price—Rs. 8·78 Paise only*]

LIST OF AGENTS

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PREFACE

THIS collection of brief silvicultural and economic notes has been compiled primarily to supply the need felt at the Orissa States' Forest School for a simple guide to the characteristics and uses of the commoner trees of Bihar and Orissa, written in such a manner as to be easily understood by students of the forester grade whose knowledge of botany is necessarily of a very elementary character and who are not, therefore, in a position to follow the more advanced works on the subject; nor, indeed, are they likely to have access to such publications. This small volume does not aim at great detail of technical description but rather bases is claim to utility on the fact that it can be readily understood by anyone having only a limited knowledge of botanical nomenclature. A short glossary is provided to explain the few technical terms that have been unavoidably used. The list of vernacular names given for each species has also been made as comprehensive as possible to assist the reader in tracing each tree; but it should be borne in mind that the vernacular names are not in themselves invariably an infallible guide and trees when traced by means of the vernacular name should be carefully checked with the description.

The provision of this small volume will, it is hoped, enable the instructor to devote more time to explanatory detail and will relieve the students of the tedious necessity for taking voluminous notes, which it was found from experience were usually incomplete and not infrequently inaccurate. Further, it will provide at a small cost a handy guide for those persons desirous of becoming acquainted with the trees of this province but who do not possess the necessary botanical knowledge to make use of the more technical books on the subject. It is admitted that illustrations would greatly enhance its value but the additional cost would have placed the book beyond the reach of many who might otherwise wish to possess it.

The number of species dealt with is 125 in all (a very brief reference being made to a few additional ones), the details of description varying with the importance of the tree. Those of outstanding importance, either silviculturally, economically or on account of their common occurrence, appear in large print. Those relegated to small print are of lesser consequence and should be studied after the important species have been mastered.

Full details of artifical regeneration, seasoning, etc., have not usually been given, except in a few cases, since this information is available in respect of the main species in a very convenient form in Howard's "Forest Pocket Book", an invaluable publication which should be in the possession of every forester.

The book has been interleaved with blank pages which can be used for making field notes and drawings of leaves, flowers and fruits. Students should be encouraged to make such notes and drawings from fresh material as a useful method of studying their flora and developing their powers of observation.

The writer is much indebted to Troup's "Silviculture of Indian Trees", Haines "Botany of Bihar and Orissa" and Gamble's "Indian Timbers", which have been freely consulted; also to several forest officers for criticisms and suggestions,

RANCHI
October 1932

PREFACE TO THE SECOND EDITION

THE original edition of "*Notes on the Common Trees of Bihar and Orissa* (1933)" has now been out of print for a number of years. Shortage of paper and other printing difficulties precluded the publication of a second edition during the war, although the need for it was felt at the Foresters' School. It has now been decided to fill this want.

As the Nicholson Foresters' Training School is now designed to serve the province of Orissa, including what were formerly the Orissa States, it has been considered desirable to change the title to the more appropriate one of "*Notes on the Commoner Trees and Shrubs of Orissa*". The text has been revised accordingly, and two exclusively Bihar species, *Hardwickia binata* and *Pinus longifolia*, have been omitted. Apart from this and a number of verbal modifications, the book remains substantially unaltered ; but the notes on teak have been brought up to date.

Many Kondh tree-names have now been added. These will require checking and very likely some revision before the list is complete and accurate. The source of the names now given is the southern Kalahandi plateau, where I collected a number myself, and the Baliguda Agency from whence Shri Niladri Rao of the Orissa Forest Department very kindly supplied me with a list. In several instances there are as many as three or four names for a given species. This may be due to variations in pronunciation or to inaccurate transcription ; but it is also quite possible that the names do vary from place to place over the extensive tract south of the Mahanadi inhabited by the Kondhs. It is also conceivable that a few names not strictly of Kondh origin have been given by Kondhs living on the fringes of the regions inhabited by other tribes and races such as the Savars, the Madias and the Telgus. It is, therefore, most desirable that the Kondh names given here should be carefully checked in the field and that those which are still missing should be supplied.

SAMBALPUR
November 1950

H. F. MOONEY
Conservator of Forests

Glossary of technical terms used in the text

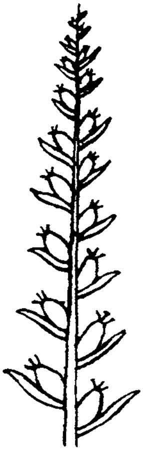
Acuminate	ending in a sharply-pointed tip
Axil	the upper angle between a leaf-stalk and the main stem
Axillary	growing in an axil
Bipinnate	Pinnate, with the pinnae further subdivided into pinnae
Bole	the stem or trunk of a tree
Buttress	large projecting ridges situated at the base of a tree extending some distance up the trunk. They are well seen inlarge *simal* trees.
Capsule	a fruit which becomes dry when ripe and splits into two or more parts.
Carpel	the carpels, when present, occupy the centre of a flower and form the ovary.
Catkin	a form of flower found in a few species in our area, viz., the willow and *Pinus longifolia.*
Chlorophyll	the green colouring matter in leaves
Compound leaf	one with two or more leaflets
Coppice, to	when a tree is cut back close to the ground it is said to be "coppiced". The young shoots which spring from the cut stump are called "coppice shoots" or "stool shoots".
Cordate	heart-shaped, or with the base heart-shaped
Corolla	a collective name for the petals of a flower ; situated within the calyx.
Corymb	see diagram below
Coriaceous	leaves that are stiff and tough, leathery
Crenate	with a wavy margin
Cyme	see diagram below
Deciduous	a tree which sheds its leaves and is leafless for a portion of the year is said to be deciduous.
Defoliate, to	to strip of leaves

Drupe	a fruit consisting of a hard stone (with one or many seeds) surrounded by soft flesh, e. g., a plum, the *ber.*
Ellipsoid	a regular oval-shaped solid, like an egg but with both ends the same.
Epiphyte	a plant which grows on another plant without drawing nourishment from its host.
Evergreen	as the word indicates, a tree that is never quite leafless
Exfoliate, to	describes the spontaneous peeling off in flakes or strips of the old bark of certain trees.
Exotic	imported ; not indigenous
"Figure"	or "figuring" when applied to timber means that the grain is wavy or twisted, which gives a pleasing appearance to the wood when polished.
Fissured	cracked ; with deep crevices
Germination	the first stage in the development of a plant : the putting forth of radicle and cotyledons by the seed.
Glabrous	without any hairs
Glaucous	bluish-green in colour
Globose	globe-shaped : globular
Gregarious	Trees which tend to form pure crops or are found in large numbers of one species together.
Indigenous	belonging to or native of a locality
Latex	a milky juice which exudes from the bark of certain trees when cut.
Light-demander	a tree requiring considerable light for its development, such trees do not thrive and some will not grow under shade.
Lanceolate	shaped like a lance-head
Obtuse	blunt
Obovate	an ovate leaf with the wider part towards the tip
Oblanceolate	lanceolate, with the wider part towards the tip or apex
Orbicular	round (in spaeking of a leaf)
Ovoid	egg-shaped (of a fruit)
Ovate	egg-shaped (of a leaf)

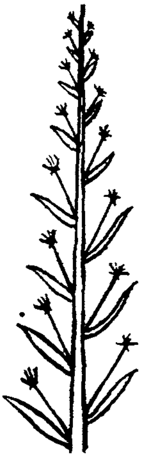
Palmate	a board leaf resembling slightly an open hand with the segments radiating like fingers.
Panicle	a compound irregularly branched receme (see diagram).
Parasite	a plant living on and drawing nourishment from the living tissues of another plant.
Petiole	the stalk of a leaf
Pinna	the branch of a bipinate leaf (plural pinnae)
Pinnate	a compound leaf with two or more leaflets springing from each side of the exis or main stalk.
Pollard, to	to cut off or lop the branches of a tree at a distance from the ground.
Pubescent	covered in short fine hairs
Radicle	the rootlet of the embryo: the first root that emerges from the germinating seed.
Raceme	see diagram below
Regeneration	young growth from seeds (seedling regeneration), coppice shoots or root-suckers.
Root-suckers	Shoots sent up from the roots of certain species at a distance from the parent stem.
Savannah	very open forest ; grass land with a few scattered trees
Season, to	to dry timber slowly so as to prevent if splitting and warping and thereby to increase its durability. Some timber is partially seasoned under water.
Serrate	having a finely toothed margin
Silviculture	the art and science of the growing and treatment ofwoods
Silviclutural	appertaining or relating to silviculture
Silver grain	when a log is cut so that the radial section is exposed, the silver grain of the timber is shown.
Spike	see diagram below
Stamen	part of a flower consisting of stalk and anther the latter bearing the pollen.
Tap-root	a long central root penetrating the soil vertically ; well seen in the case of sal.
Trifoliate	**a leaf having three leaflets**

Tannin ..	a substance containing tannic acid found in the bark, fruits and leaves of many trees, which is used in the preparation of leather from raw hide.
Whorled	branches radiating in tiers like the spokes of a wheel from the trunk of a tree, e. g., *simal.*
Xerophilous, xerophytic.	descriptive of plants specially adapted for economizing their water-supply and found growing in very dry, hot, sandy regions. They are called xerophytes.

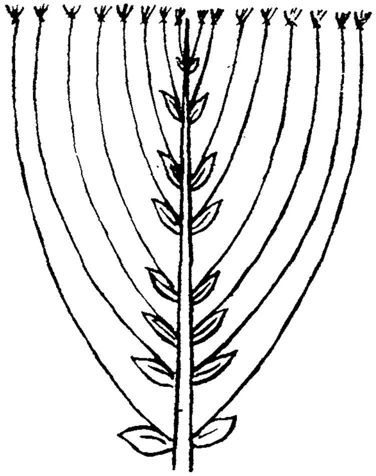
DIAGRAMATIC REPRESENTATION OF VARIOUS TYPES
OF
LNFLORESENCES



SPIKE



RACEME



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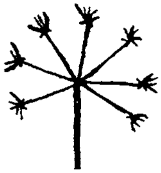
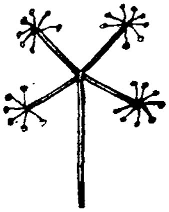


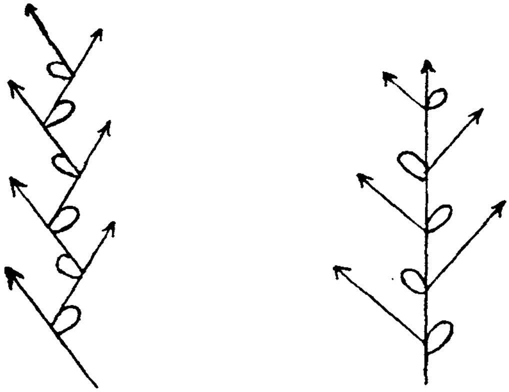
Simple Umbel



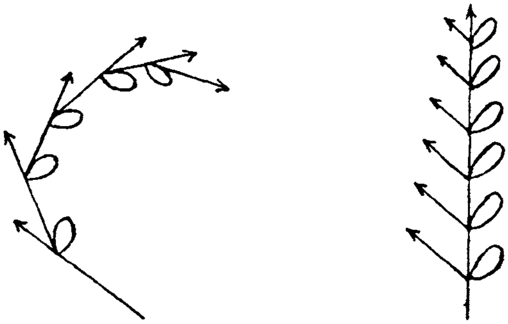
Compound Umbel

UMBEL

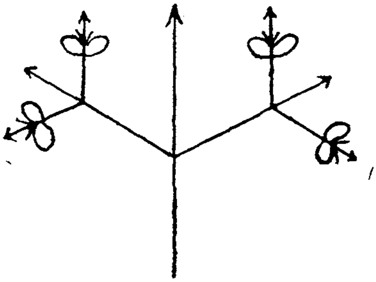
FORMS OF CYMOSE BRANCHING



SCORPIOID

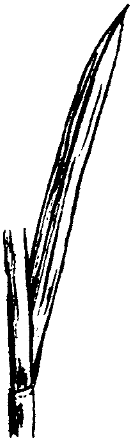


HELICOID

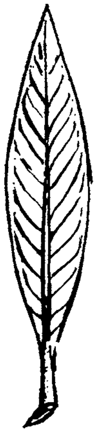


BIPAROUS

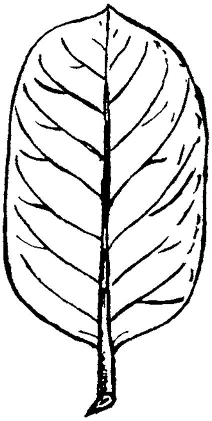
DIAGRAM OF THE COMMONER FORMS OF LEAVES



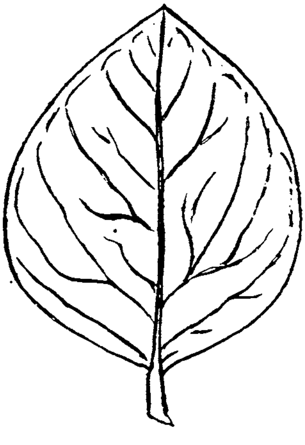
Linear



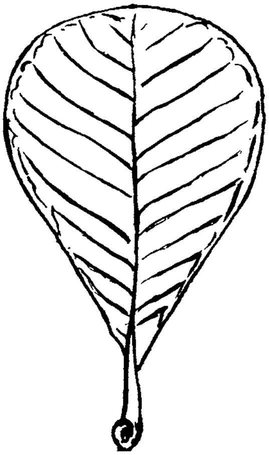
Lanceolate



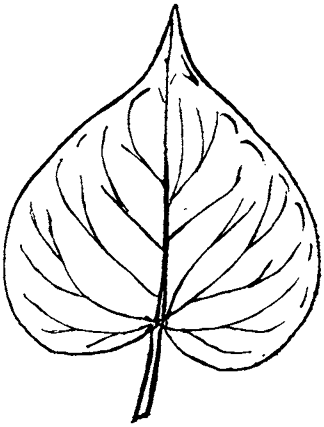
Oblong



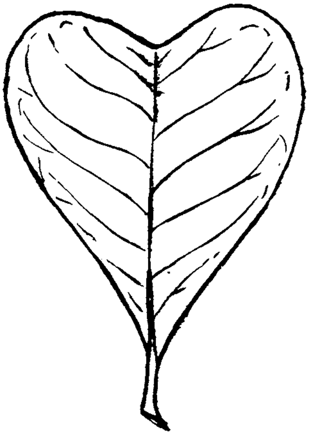
Ovate



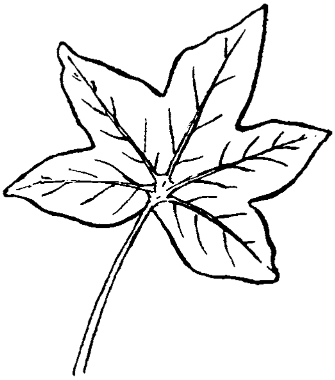
Obovate



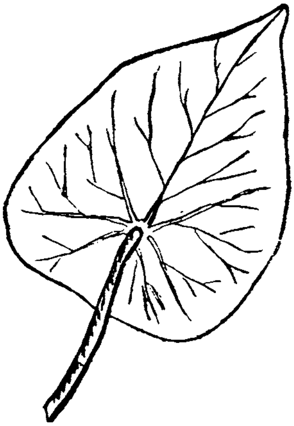
Cordate



Obcordate

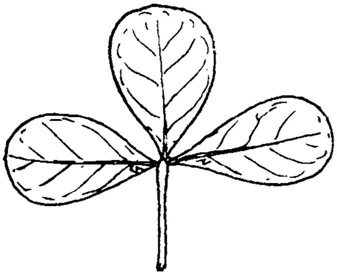


Palmate

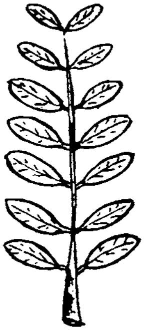


Peltate

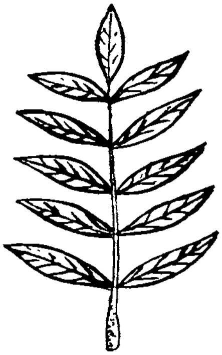
COMPOUND LEAVES



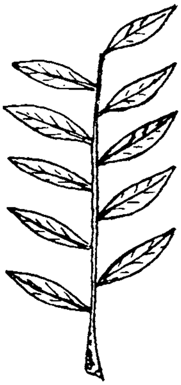
Trifoliate



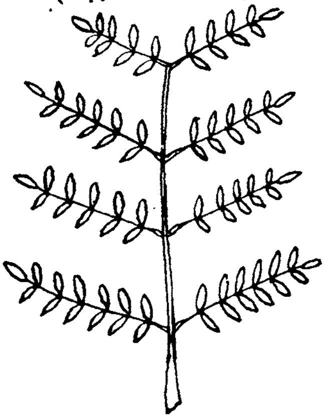
Paripinnate
(Opposite leaflets)



Imparipinnate
(Opposite leaflets)

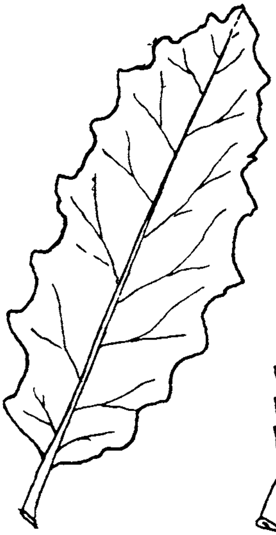


Pinnate
(Leaflets alternate)

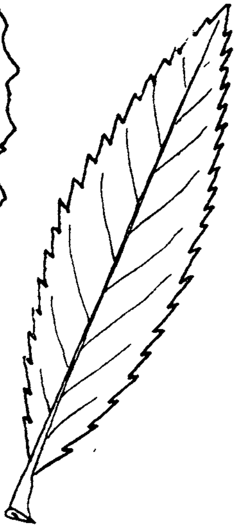


Bipinnate

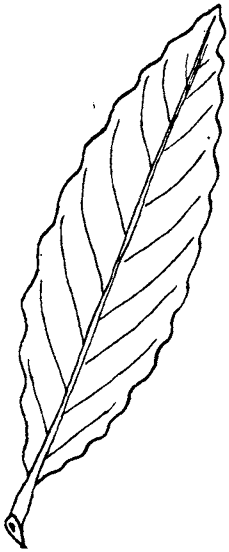
MARGIN OF LEAVES



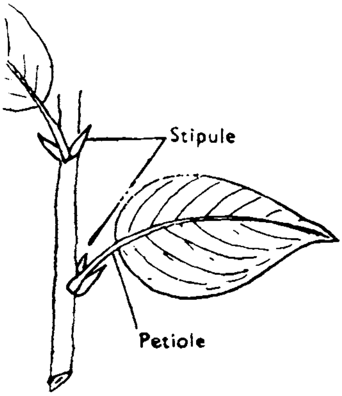
Dentate



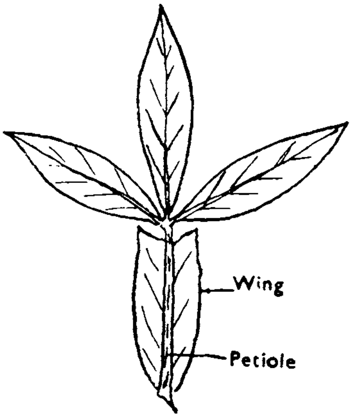
Semate



Crenate



STIPULE



WINGED PETIOLE

FAMILY: DILLENIACEÆ

1. DILLENIA PENTAGYNA

Local names—Rai (Oriya) ; Sahar (Santali) ; Keringila (Sambalpur); Rail, Karambali (Kondh).

General description—A moderate-sized deciduous tree attaining 50—60 ft. in height and 4-5 ft. in girth with smooth, light coloured bark, often fissured vertically. Very large serrated leaves 12″—36″ long, being largest in the case of young saplings and coppice shoots. The flowers are yellow and appear in great numbers on the leafless branches in March-April. The fruits are orange in colour, ½″—¾″ in diameter. Seeds, small, dark brown and shining. Leaves fall in January-February.

Distribution and habitat—A fairly common tree, especially in Angul, Puri and the neighbouring States. Usually confined to the valleys, especially at the higher elevations.

Silvicultural characteristics—The tree is a light-demander. It is sensitive to frost but withstands fire well. It usually coppices freely. It reproduces aboundantly from seed, especially in burnt savannahs. Growth is fairly rapid. A very difficult tree to kill by girdling.

Uses—The wood is reddish-grey and durable but liable to warp and split. However, it has an excellent "figure" if cut on the "quarter" (radial section), and if properly seasoned should make a first-rate cabinet wood. It is a good fuel and yields a good quality charcoal. The fruits are edible.

Dillenia aurea (*Rai*, *Oriyai*, *Keringila*, *Kermela*, Sambalpur) is much smaller than the foregoing, has a rough, dark bark and is more usually found on dry hill tops. The leaves are smaller and the tree rarely attains 30" in girht. The wood is very similar to that of *D. Pentagyna.* Fruits 2″-2½″ in diameter, sweet-smelling and sometimes eaten.

Dillenia indica (*Oao*, *Oriya*) is a beautiful evergreen tree, commonly planted in Anandpur subdivision of Keonjhar state. The flowers, which appear in the hot weather, are white and 5″-6″ in diameter. The fruit is large and is eaten. It does not occur in the wild state in Orissa, but is found in the north of Purna in Bihar.

FAMILY: MAGNOLIACEÆ

2. MICHELIA CHAMPACA

Local names—Champa, champ, champaka (Hindi and Oriya); hapa (Kondh).

General description.—A large evergreen tree, 60—80 ft. or more in height and attaining 6-7 ft. in girth. The leaves are lanceolate and acuminate, about 8″—12″ long by 2″—4″ broad. The flowers are yellow, sweet-scented and about 2" in diameter. The bark is pale grey in colour and smooth. The seeds are scarlet in colour. It flowers in April-May (August-September in Ranchi) and fruits in July-August.

Distribution and habitat—A rather rare tree, found only in cool, damp valleys, usually above 2,000 ft. elevation, and generally in shady positions with a northerly aspect. Seen at Netarhat, Palamau; Karampoda, Singhbhum ; east Bonai ; Kasiput plateau, Kalahandi; and noticeably common in places in the Similipal Hills of Mayurbhanj.

Silvicultural characteristics—A moderate light-demander. The tree coppices well, is frost-hardy and fire-tender.

It can be grown from seed, which should be sown as soon as possible since it quickly loses its power of germinating. Seedlings may be transplanted in the second year after sowing. Growth, rapid.

Uses—The wood is soft, even-grained and easy to work. It is light and strong and has a good appearance. It is useful for many purposes especially for furniture. When freshly cut it is purplish in colour but changes to olive-brown on exposure. It is durable and is said to be proof against white ants.

It is cultivated near temples for its frangrant flowers.

FAMILY: ANONACEÆ

3. POLYALTHIA LONGIFOLIA

Local names—Debadaru (Oriya), deodar, sometimes Ashok

General description—A straight evergreen tree, 50—60 ft. in height, with narrow lanceolate acuminate leaves, 3″—8″ long. An exotic tree from Ceylon, cultivated in gardens and avenues. It thrives in the moister districts of Cuttack and Puri ; and there is a fine avenue at Purnagarh in Angul. The seeds ripen in July-August but do not long retain their germinative power. Flowers in March-April. It does not stand transplanting well.

The wood is said to be used for making barrels in Madras as it is tough and bends easily. It is not generally used in our area.

4. POLYALTHIA CERASIOIDES

Local names – Sande ome (Ho) ; Kudumi (Hindi) ; Potmossu? (Oriya), through confusion with *Miliusa*.

General description —A small tree 20—30 ft high with spreading branches. Leaves, dark green, lanceolate, acuminate, 5"—8" long by 1½″– 3″ broad. Flowers greenish, about ½″ in diameter.

Fruit, an umbel of many slender stalked, bright red, globose, oblong fleshy carpels, 3″ long. Flowers, April-May, Fruit, May—August, Almost evergreen.

Distribution and habitat—Frequent in Orissa, especially in damp valleys. Common in the Mals of Puri, Angul and valleys in Singhbhum.

Silvicultural characteristics—A shade-bearer, preferring moist localities. It produces root-suckers.

Uses– The wood is fairly heavy and is said to be used in carpentry and boat-building. The fruit is sweet and is eaten.

5. MILIUSA VELUTINA

Local names– Kari, domsal (Hindi) ; gandha-palas (Oriya) ; Domgaru (Khond) ; Ome (Ho, Santali) ;

General description– A medium-sized deciduous tree, 4-5 ft. in girth with a short trunk, spreading branches and a large crown. The bark is dark grey and longitudinally fissured. The green flowers appear in May-June ; the fruit ripens in June-July. The tree is leafless about February-March.

Description and habitat—It occurs throughout the province, generally in the damper types but also in the open mixed deciduous forests. A characteristic tree of many sal forests.

Silvicultural characteristics—The tree is somewhat frost-tender, but is very hardy against drought. It is of special value as a nurse to sal in open grassy blanks . It coppices well and reproduces from root-suckers. The rate of growth is not rapid, coppice shoots showing slower growth thansal.

Uses—The wood is moderately hard, durable, fairly elastic and easily worked. It is yellow when freshly cut but it turns grey or greyish-brown on drying. It is used for yokes and axles and makes good axe handles. The fruit is eaten.

6. SACCOPETALUM TOMENTOSUM

Local names—Ome, ombe (Ho) ; Kari, (Hindi) ; Patmosso, gandha-palas (Oriya).

General description.—A small or moderate-sized deciduous tree with solitary purple flowers. It attains a girth of 4-5 ft. but is more usually a small tree. Bark, brown, nearly smooth, with numerous small cracks in young trees : fissured in old ones. Leaves, ovate-oblong, obtuse. Flowers, May-June ; fruits, June-July.

Silvicultural characteristics.—One of the companions of sal. It coppices well, the rate of growth being somewhat less than that of sal.

It is of little economic importance, but the timber is used for house-posts and is strong and durable.

CAPPARIDACEAE

7. CRATAEVA RELIGIOSA

Local names—Barun, varuna (Hindi, Bengali, Oriya)

General description—A moderate-sized, deciduous tree with long-petioled trifoliate leaves. The bark is grey and somewhat smooth, with horizontal wrinkels. The flowers are very showy, about 2½" in diameter, varying from cream to yellow and pink with purple stamens. It is found chiefly along streams. A rare tree, but more frequent in Puri, Cuttack and along the Mahanadi than elsewhere. It is cultivated. Flowers March-April ; fruit, June ; leafless January– March.

Silvicultural characterstics– More a light-demander than a shade-bearer. It prefers a deep, loose, aulluvial soil near streams. It has a long tap-root. It is sensitive to frost in its early stages. It produces root-suckers freely and is best propoagated artificially by transplanting.

Uses– The wood is soft, white and even-grained,. It is used for drums, writing-boards, combs and in turnery. It is a suitable wood for match splints.

BIXACEAE

8. COCHLOSPERMUM GOSSYPIUM

Local names– Galgal (Hindi) ; golgol (Bengali) ; ganiari, kontopalas (Oriya) ; gonel (in Patna and Kalahandi) ; gelgela (Sambalpur) ; gongai (Khond) ; hupu (Ho).

General description– A small straight, soft-wooded tree with palmately 3– 5 lobed leaves and fibrous, fissured bark, bearing when leafless, large yellow flowers 4– 5" in diameter, which are succeeded by large pear-shaped fruits. Flowers in the hot season.

Distribution and habitat—Throughout the province on the hottest, driest aspects and on the most stony soils.

Silvicultural characteristics—The tree is a light-demander. It is fire-resistant and coppices fairly well.

Uses— The wood is soft, fibrous and quite useless. The silk-cotton obtained from the capsules is similar to that of the simal tree and used for the same purposes.

GUTTIFERACEÆ

9. GARCINIA COWA

Loca lnames—Rajkusum (Oriya) ; Soroa (Ho); Kowa (Bengali).

General description—An erect shade-bearing tree with dark shining lanceolate leaves 3"—5" long. Flowers, yellowish, fleshy and sweet-scented. Fruit, yellow, 2" in diameter, some what pear-shaped with five sections indside, rather resembling those of a small orange. It is edible and very pleasant. This is an extremely rare tree, only found along streams in deep cool ravines. Seen in Rairakhol and Athmallik along the Aunli nadi ; at the foot of the Kandadhar waterfall in Bonai state ; in Tholkobad block, Saranda, Singhbhum, at Jalha, Pal-Lahara, and near Kural in Athmallik.

10. CALOPHYLLUM INOPHYLLUM

Local names—Punang (Oriya)

General description—A moderate-sized evergreen tree with short thick, often crooked, bole, dark brown or blackish bark, handsome white flowers and dense, dark green shining foliage. Fruit, yellow 1″ in diameter. Flowers, May-June and October-November ; fruits October-November and April-May.

Distribution and habitat—Orissa coast : extensively cultivated but doubtfully wild. Grows best on deep soil near the coast but will thrive on pure sand.

Silvicultural characteristics—The tree is said to be brittle and liable to damage by wind. It can be raised easily from seed provided it is sown soon after ripening.

Uses—The seeds yield an oil known as "Dumba oil", used for burning and as a substitute for castor : possibly in soap-making. The timber is moderately hard, reddish-brown and close-grained.

11. MESUA FERREA

Local names—Nagesar, nageswar (Oriya, Bengali).

General description—A moderate-sized or large, very beautiful evergreen tree, with a straight trunk branching close to the ground. Leaves, narrow lanceolate, 3″—6″ long, drooping, shining above, whitish beneath. Flowers, very fragrant, 1″—3″ in diameter, from April to July. Fruit, October-November.

Distribution and habitat—Undoubtedly indigenous on the eastern slope of Malyagiri Hill in Pal-Lahara where it occurs over several acres in a moist valley at about 2,000 ft.; also along the upper valley of the Kosai river in Rebna forest, Keonjhar ; and there are a few trees on the Routha plateau in Bonai.

Silvicutural characteristics—A decided shade-bearer in youth. Frost-tender ; also susceptible to fire and drought. Coppicing power is said to vary. Regenerates profusely from seed in Pal-Lahara.

Uses—The timber is red in colour, very hard and very heavy. It is difficult to work, but is suitable where durability and strength are required and where weight is immaterial. It is used for sleepers and agricultural implements outside our province.

DIPTEROCARPACEAE

12. SHOREA ROBUSTA

Local names—Sal (Hindi, Bengali, Oriya) ; Salua, sargi, rengal (Oriya) ; Sarjom (Ho, Santali, Mundari) ; jargi (Kondh).

General description—A large gregarious tree, seldom quite leafless with shining foliage. The mature leaves are somewhat coriaceous, ovate-oblong with a cordate base, 4″—8″ long. The crown is conical in youth, afterwards rounded with a strong branching system. The bole is clean and straight in forest-grown trees.

In saplings the bark is smooth with a few longitudinal cracks and is greyish in colour : that of older trees is dark-brown (sometimes reddish), 1″-2″ thick, with deep longitudinal furrows. In very old trees the bark is sometimes almost smooth and grey in colour.

In favourable localities sal reaches a height of 120 to 150 ft. and a girth of 12 ft. and more. Some trees measured in Saranda were 150 ft. in height and 70—80 ft. to the first branch. Such trees are rare and the average dimensons of good sal may be taken as 70—100 ft. in height and 5—7 ft. in girth. On poor soils the height is often less than 40 ft.

The flowers are cream-coloured in panicles 5″—9″ long. They appear in March-April. The fruit is about ½″ in diameter with wings 2″—4″ long. It ripens in June-July. The leaves fall in February-March but are soon renewed, the new leaves appearing with the flowers.

Distribution and habitat—Sal occurs throughout Orissa as far south as latitude 18°=30′ where it disappears. It does not extend as far south of the Godaveri river. It is found on the tops of the highest hills (up to 4,300 ft. at least on Nimgiri in Ganjam) and within a few miles of the cost in Cuttack and Puri.

It attains its best growth on deep, well-drained, sandy loam. A good supply of water in the sub-soil is essential, water-logging being inimical to its growth. The cooler northerly and north- easterly aspects are favoured, although stunted trees may be found growing on hot, stony, southerly hillsides. Nevertheless, it grows best on lower slopes and in valleys where the soil is deep, moist and fertile. Sal is not often found in sandy and shingly river beds owing to the low water contents of the soil.

In our area sal is found on a variety of geological formations, the chief of which are gneiss, mica-schist, quartzite, shale, sandstone and laterite. It also occurs on alluvial ground over-laying older rocks. A high percentage of iron in the soil is not detrimental to the growth of sal; it is probably beneficial (e. g. in Singhbhum district.) It is found on lime (ghooting) soils but the growth is very stunted ; these soils are usually very clayey.

The chief associates of sal are:—

(*i*) In dry type forest—*Terminalia tomentosa*, *T. chebula Pterocarpus marsupium*, *Anogeissus latifolia*, *Bassia latifolia*, *Dios-epyros melanoxylon*, *Buchanania latifolia*, *Eugenia jambolana*, *Terminalia belerica*, *Ougenia dalbergiodes*, *Stereospermum suaveolens*, *Careya arborea*, *Lagerstroemia parviflora*, *Emblica officinalis*, *Dalbergia*, *latifolia*, *Bursera serrata*, *Odina wodier* ; and bamboos (*Dendrocalamus strictus*) on poor soils.

(*ii*) The damp type forest found in deep valleys in Singhbhum, Angul, Puri, Bonai, Bamra, Athmallik etc., contains many of the species mentioned above but of better growth, to which may be added *Michelia champaca* (in Saranda, Bonai and Mayurbhanj) *Dillenia pentagyna*, *Mangifera indica*, *Pterospermum hyeneanum* and others. *Millettia auriculata* is very common as a climber and as an undershrub in these forests, also *Mallotus philippinensis* as an undershrub and a small tree. *Clerodendron infortunatum* is another common weed in damp type forests.

(*iii*) On lime soils *Soymida febrifuga*, *Acacia leucophloea*, and *Acacia catechu are* found in association with it.

(*iv*) On sandstone and laterite in Puri, *Xylia xylocarpa*, *Ptero-spermum heyneanum* and *Dillenia pentagyna* are its frequent companions together with several of the species mentioned under (*i*).

(*v*) The poorest type is found on shales decomposing into clay with quartz pebbles on the surface. Here the sal seldom exceeds 25 ft. in height and is accompanied by stunted *Gardenia gummifera*, *Buchanania latifolia*, *Terminalia tomentosa*, *Anogeissus latifolia*, *Dillenia aurea*, *Diospyros melanoxylon*, *khejur* (*Phoenix acaulis*) shrubs and *sabai* grass.

Silvicultural characteristics— Although able to persist under shade, sal is strictly speaking a light-demander. Young plants require some protection from frost and drought but otherwise benefit by a fairly full exposure to light.

Sal is, however, very tolerant and can exist under a variety of conditions. It is somewhat frost-tender but is fire-hardy. It is not seriously affected by drought unless there is a great fall in the level of the sub-soil water. It coppices well up to a girth of 3 ft., and healthy stools of 4 ft. in girth will produce shoots quite frequently. Under favourable conditions the coppice shoots make rapid growth and attain a large size (at least 5 ft. in girth) without showing signs of deterioration.

Sal produces a strong tap-root, which may be 3 ft. long by the end of the first season. It also demonstrates well the phenominon of dying back, whereby the seedling dies back year after year (the causes of its doing so being various) until the root system has become well established, when a strong shoot is put out and continued upward growth follows. A seedling may die back for many years (10 or 12 or even more) before sending out a strong shoot.

Sal is not very susceptible to external damage and has good powers of recovery. The following are forms of injury to which it is liable.

(1) Browsing by cattle and deer in the seedling stage and especially in young coppice crops.

(2) A fungus (*Polyporus shorea*) attacks the roots and causes death.

(3) A heartwood borer (*Hoplocerambyx spinicornis*) attacks fallen logs which have not been barked and also sickly trees.

(4) A defoliating caterpillar strips the trees of their leaves in the month of May, but a fresh frush of leaves is put forth and the damage done is slight.

(5) *Loranthus longiflourus*, a branch parasite is found on sal and is more especially noticeable in pole crops. It induces stag-headedness and top-dryness and may damage the tree considerably, if it does not kill it.

(6) Sal is susceptible to frost especially in the younger stages of development ; but frost is virtually absent in Orissa except locally in Bonai and N. Keonjhar, and in some of the higher hills of Koraput and Kalahandi.

(7) Drought, if severe enough to cause a fall in the sub-soil water level, may cause serious and widespread mortality. It becomes evident by the trees becoming top-dry, generally in patches, or over a considerable area.

Reproduction—(*a*) Natural.

(1) *Seeding and germination*—In most of the forests of this province sal reproduction is plentiful. Points of importance, which influence reproduction are as follows :—

(*i*) A good seed year coinciding with an early break of the rains.

(*ii*) A clean seed-bed into which the radicle of the germinating seed may readily penetrate. A thick layer of sal leaves most effectually prevents the radicle reaching the soil.

(*iii*) Exposure to the sun causes the seed to perish ; hence moderate or even heavy shade is favourable to germination.

(*iv*) It is advantageous to burn the leaf layer when a good seed year is anticipated.

(2) *Establishment*—After germination the seedling may take a considerable time (several years perhaps) to establish itself ; the length of time depending on a number of factors, the chief of which are :—

(*i*) A well-aerated, deep, loose, fertile soil encourages the rapid development of the seedling ; while a heavey, badly-drained soil causes it to die back for a long period.

(*ii*) A deep layer of dead leaves is injurious to growth.

(*iii*) Of great importance is the presence of adequate light. Some slight protection from direct sunlight may be desirable in the earlier stages of development, especially if a heavy growth of grass is feared ; but seedlings will not finally establish themselves until given full overhead light by the complete or almost complete removal of the canopy.

(*iv*) Protection against such adverse influences as grazing, frost and fire are essential if the young crop is to become established rapidly.

(*b*) *Artificial*—Artificial regeneration of sal will rarely be necessary, and it is certainly difficult to produce really good results without extreme care. The seed cannot be stored for long and must be sown within a few days of collection, since it retains its vitality for a very short time.

Probably the most important factor influencing the raising of sal by artificial means is soil cultivation ; and secondly weeding until the seedlings become established. Without good soil preparation failure is practically certain.

Sal is difficult to transplant owing to its long tap-root and therefore direct sowings are advisable. If transplanted, the taproot must be prouned.

Probably the most suitable and economical method of raising sal artificially in this province would be by *taungya* or *toila* cultivation, i.e. with field crops.

Uses : (a) Timber—Sal timber is reddish-brown in colour. It is coarse, hard, heavy, strong, durable and cross-grained. Annual rings are indistinct except in young trees. It is mainly in demand for sleepers and structural timber where strength and durability are chiefly required. The heartwood is proof against white-ants if seasoned, but the sapwood is white and soft and not durable unless treated with some preservative. Sal is used for rough furniture such as tables, chairs and benches but as it does not take a good polish and as it is difficult to work, it is not used for high grade furniture. It is in great demand for the manufacture of agricultural implements and bodies of carts and is the chief plough timber of this province. It is also used for dug-out canoes in Orissa. The *ballis* or poles are extensively used for house-building.

Sal planks are used in the construction of country boats : a considerable business at the town of Cuttack. Sal timber cannot be floated without extraneous support. It weighs between 50 and 60 lbs. per cubic foot when dry.

(b) Other products—The fruit is occasionally eaten by the poorer classes, and a vegetable oil used for cooking and burning is extracted from it. It is very inferior in quality.

The leaves are used as plates and as a covering for the *phika* or cigarette of the Hos.

The bark contains tannin but is not in much demand for tanning.

When tapped, the tree yields a resin known as *dhup*, which is used as incense and for caulking boats. A large percentage of the old trees in Singhbhum and the adjoining districts of Orissa were previously damaged by being tapped for resin, becoming defective near the base where injured.

Sal is a good fuel and yields a very high grade of charcoal.

MALVACEÆ

13. KYDIA CALYCINA

Local names—Ban Kopasia (Oriya) ; pula, baranga (Hindi) bita-goinr (Ho) ; *balings*, *Kopasya* (Kondh).

General description—A moderate-sized deciduous tree with grey bark, exfoliating in long strips or irregular flakes. It rarely reaches 3 ft. in girth. Leaves, palmate with 5—7 nerves. Flowers, white, in panicles, from September to November. Fruit, December to May. The leaves commence to fall in December.

Distribution and habitat—Throughout the province in valleys and on hill slopes, more especially in valleys containing mixed forest.

Silvicultural characteristics—A decided light-demander, but will stand shade in youth. It is short lived. The tree reaches 40—50 ft. in height and is a useful nurse for sal provided it is cut back if it gives too heavy shade. It is fairly frost-hardy and resists drought well. It coppices freely and produces root-suckers. The growth is rapid : 25—30 ft. in five years.

The tree reproduces well from seed, especially in damp localities. It transplants satisfactorily.

Uses—The wood is white and soft. It is not used locally but is a potential match wood. The bark gives a fibre.

14. SALMALIA MALABARICA

(Syn. *Bombax malabaricum*)

Local names—Simli, simuri (Oriya) ; simal (Hindi) ; edel (Ho, Santali) ; dakang, lak, leka (Kondh); the silk-cotton tree.

General description—A very large deciduous tree with a straight cylindrical stem and horizontally spreading branches in whorls ; large trees are nearly always buttressed at the base. Bark, smooth, grey, ¾″—1″ thick ; that of young trees being covered with sharp prickles. The leaves have 5—7 eafletsl. It attains a height of 130 ft. and a girth of 12 ft. above the buttresses is not uncommon. Boles are often 80—100 ft. to the first branch in forest-grown trees. The flowers are large and red and appear from January to March when the tree is leafless. The fruit ripens from March to May in capsules 5″—7″ long, which contain numerous seeds embedded in a white silky floss.

Distribution and habitat—Throughout the province, attaining its largest dimensions in damp, cool valleys on a deep fertile soil. It is most common on alluvial soil near river banks and is most frequently associated with forest of the mixed deciduous type. It will grow on poor soil but is stunted.

Silvicultural characteristics—The *simal* is a strong light-demander. It withstands drought very well. Old trees resist fire ; and young saplings and seedlings have a strong power of recovery if burnt back. It will resist a slight frost but not a severe one. It coppices when young but not later on. It is much damaged by grazing.

Reproduction— Natural regeneration establishes itself freely under favourable conditions ; on alluvial flats, savannahs and open spaces. It requires protection from grazing. Dense weed growth hampers the development of seedlings. It springs up readily on abandoned cultivation given protection from fire and grazing.

It does not transplant very successfully and can probably be best raised artifically by sowings in conjunction with field crops.

Growth, very rapid, a girth of 6 ft. being reached in 20—25 years under favourable conditions.

Uses—The wood is light, soft and white when freshly cut. It is not strong or durable, but is well suited to such work as packing-cases. It is fairly durable under water ; for this reason it is used to make canoes in some parts. The wood is used for making match-boxes ; also toys and scabbards.

The cotton which surrounds the seeds is used for stuffing pillows and quilts (*razai*).

The gum is used medicinally and is said to be a cure for diarrhoea.

STERCULLIACEAE

15. Sterculia urens

Local names—Girdhini, giringila, genduli, bhendiamardan (Oriya) ; Teley (Ho) ; Telhec (Santali) ; kube, gulu, (Hindi) ; Kullu ; gendani (Kondh).

General description—A large or moderate sized tree. Bark, ½″ thick, very smooth, greenish-white, exfoliating in thin papery flakes. Branches, spreading and marked with large scars. A very conspicuous tree on dry hillsides. Leaves, large, 5-lobed. Flowers, December to February ; fruit, April ; leafless from December to May.

Distribution and habitat—Throughout the province. Most characteristic of dry open forests and rocky hills, where it thrives in hot, exposed positions.

Silvicultural characteristics—A xerophytic tree. It is a strong light-demander, very resistant of drought and will grow on the poorest of dry stony soils. It coppices when young.

Uses—The wood is soft, reddish-brown and not durable. It is little used but is said to be employed in the manufacture of musical instruments and toys.

It yields a colourless gum called *katila*, or kuller gum which is used in medicine and is also exported to America it is said.

The seeds are edible and the bark yields a fibre.

16. STERCULIA VILLOSA

Local names—Kodalo (Oriya) ; udal (Hindi), sisi (Ho) ; ganjher (Santali) ; kodedi (Kondh).

General description—A large deciduous tree with grey or brown bark covered with corky nodules ; branches showing large leaf scars. The large palmate leaves fall in November-December and the tree remains leafless till May or June. The panicles of yellowish flowers appear in January and the fruits ripen in May-June. The seeds do not retain their vitality very long.

Distribution and habitat—Throughout the province but nowhere very common. More frequently met with in Angul than in other districts. It is generally associated with miscellaneous species in mixed forest and is more often found in the valleys or on cool hill-sides, whereas *S. urens* commonly affects hot exposed situations.

Silvicultural characteristics—The tree is a strong light-demander and its growth is rapid : 15—20 ft. in four to five years. It coppices well. It does best on a light sandy soil.

Uses—The wood is greyish-brown in colour, very soft and light and of no use. A coarse, strong fibre is obtained from the bark and is used for making ropes and coarse bags.

It yields a white gum.

Sterculia colorata—Pani kodalo (Oriya); pandari-kudar, (*Khond*); sisi, (*Ho*, *Mundari*); udal, (*Santali*). A moderate-sized, rarely a large deciduous tree, remarkable for its strikingly beautiful panicles of scarlet flowers which appear in March-April, when the tree is leafless.

It occurs throughout the province but is nowhere very abundant, except perhaps on the Kasipur plateau (3,500 ft.) in Kalahandi. It affects cool, shady localities rarely far from a stream. It is recorded from Angul, Mayurbhanj and Bonai.

The timber resembles that of the other *Sterculias* and the bark is likewise used for ropes.

17. HELICTERES ISORA

Local names—Mura, murimuri, patmori, antia (Oriya) ; Poto, porla, sinkari (Ho) ; petkamra (Santali) ; murad, maraphal (Hindi); pita baranga (Khond) ; pita kuruan (Sambalpur) ; kapel (Kondh).

General description—A deciduous shrub, rarely a small tree, with broadly oblong or rounded leaves. Scarlet flowers, April to December. The fruits are spirally twisted and ripen in October-January. The young shoots are covered in soft hairs.

Distribution and habital—Throughout the whole province in the undergrowth. Noticeably common on the northern aspects of hills especially in mixed forest. It appears to be rather more common in the centre (Angul) and west of Orissa (Patna, Kalahandi, Bamra and Gangpur) than elsewhere.

Silvicultural characteristics—It bears shade well although it reaches larger proportions if the shade is not too heavy. It coppices very freely.

Uses—The chief product of this plant is the fibre obtained from its bark. The fibre is strong and, if carefully cleaned and dried, is white in colour ; but it is difficult to clean.

18. PTEROSPERMUM HEYNEANUM

Local names—Giringa (Oriya) ; machkhund (Sambalpur) ; gadamranu (Kondh).

General description—A small or moderate-sized evergreen tree, with coarsely toothed (dentate) leaves, 3″—6½″ long. Flowers, white, sweet-scented, 3½″—4″ in diameter. The fruit is a capsule 2″—3″ long. It flowers in October-December and fruits April-May.

Distribution and habitat—Frequently met with in Orissa, especially in Puri, where it is one of the commonest trees in the poorer forests towards the coast. It is found on conglomerate and sandstone in Chandka, and on metamorphic rocks in the Banpur Mals. It generally occurs in damp cool valleys and not in the hotter and drier districts. It appears to be invading the undergrowth in *sal* forest in the Mals of Puri as a result of fire protection.

Silvicultural characteristics—A shade-bearer. It coppices freely and also reproduces abundantly from seed. Seedlings of *giringa* are a common feature of the undergrowth in shady ravines on steep slopes in Puri and Angul. Growth fairly fast.

Uses—The timber is light-red in colour and is moderately hard. It is used mainly as fuel but also for other domestic purposes.

TILIACEAE

19. GREWAIA TILIAEFOLIA

Local names—Dhaman (Hindi, Oriya) ; baranga (Chhattisgarhi) ; mohru (Khond) ; jang, olat (Santali) ; ahsing, gonyer (Ho) ; kultho (Mayurbhanj ; kichali (Kondh).

General description—A small to moderate-sized deciduous tree, rarely exceeding 3ft. in girth, with broadly ovate leaves, usually having unequal sides. Bark, nearly smooth, sometimes with faint rings. Flowers, from April to June. Fruit, September-October. Deciduous April-May.

Distribution and habitat—Occurs in all the drier types of forest throughout the province, more commonly in association with miscellaneous species than with sal. It is generally most common on the higher and steeper hill-slopes having a northerly or easterly aspect. In such localities it is frequently found with *Ougeinia dalbergioides* and bamboos. It is common in Angul and Daspalla.

Silvicultural characteristics—The tree is a light-demander but will bear shade and is frequently found as a shrub in the undergrowth. It coppices freely and produces root-suckers. The rate of growth of copice shoots is very rapid, two year-old shoots attaining 10—15 ft. in height and 2″—7″ in girth. A very hardy species.

Uses—The heartwood is brown in colour, moderately heavy, tough and elastic and has a very handsome silver grain. It is used for shafts, shoulder poles (*bahangi*), masts, bows and axehandles.

The inner bark yields a fibre and the fruits are eaten.

20. ELAEOCARPUS ROBUSTUS

Local names—Poinsia, nard champa, patragundi (Oriya): *Musoria* (*Kondha*).

General description—A large evergree tree attaining 6 ft. in girth with a smooth pale bark and large oblong, acuminate, crenate or serrate leaves, 7″—12″ long, which turn red before falling. Flowers, white, about 1½ in diameter in lax racemes. Fruit, an elipsoid drupe 1″—1½″ long.

Distribution and habitat—In deep valleys in evergreen forest. Common in Rajin and Tamna blocks, Puri ; East Bonai ; Pal-Lahara ; Mayurbhanj ; Kasipur in Kalahandi ; below Rasanda in Angul.

Gamble states that the wood is " white, shining, soft and evengrained. Weight, 38 lbs. "

EUPHORBIACEAE

21. CROTON OBLONGIFOLIUS

Local names—Masundi (Oriya) ; putri (Bengali) ; kuti, kuti-konyer (Ho) ; gote (Santali).

General description—A small deciduous tree or more commonly a shrub occasionally attaining 2 ft. in girth. Bark, grey or brownish and about 1″ thick. The leaves are oblong or elliptic, 4—12″ long usually coarsely toothed and turn red before falling in March. Flowers, January-February ; fruit, April.

Distribution and habitat—Very common in Chota Nagpur where it frequently occurs gregariously in scrub jungle. Not so common in Orissa. An important associate of sal in the undergrowth in places.

Silvicultural characteristics—It coppices well and produces root suckers. It does not stand heavy shade. Its rate of growth from coppice shoots is slightly less than that of sal. It prefers dry localities.

Uses—The wood is yellowish and fairly hard. It is not much used owing to its small size, except as fuel. The leaves, bark and fruit are used in medicine, as a purgative.

22. TREWIA NUDIFLORA

Local names—Pitalu, panigramhari (Oriya, Bengali) ; pani-gamhar (Hindi) ; Gara loa (Ho) ; Gara lopong (Santali) ; Tabhar (Mayurbhanj) ; *bhita* (Kondh).

General description—A moderate-sized or large deciduous tree, often with a short bole and spreading branches. Frequently buttressed at the base. Leaves, opposite, with a long petiole, broadly ovate and cordate at the base. The tree slighlty resembles *Gmelina arborea*. Leafless from December to March. Flowers, January to March. Fruit, a berry 1″—1½″ in diameter, ripening from October to December.

Distribution and habitat—Throughout the province in moist swampy situations along rivers and streams. Locally common along Mahanadi. Requires a moist alluvial soil.

Silvicultural characteristics—A moderate light-demander. Coppices very freely and produces root-suckers. Fairly frost-hardy but is susceptible to drought.

Uses—The wood is white in colour, soft and not durable It has been tried and found satisfactory for matches.

23. MACARANGA PELTATA

Local names—Manda (Puri) ; piania, gondaguria (Oriya) ; tabhari (Mayurbhanj).

General description—A small or moderate-sized evergreen tree with greenish branches and smooth, thin, greenish-grey bark, exuding a sticky juice when cut. Leaves, large, 4″—12″ in length, peltate (i.e. shaped like a shield, the petiole being attached to the centre and not to the edge of the leaf), orbicular-ovate, accuminate, densely hairy when young. Flowers, small ; males in short panicles females in short cymes, appearing in March. Fruit, a globose capsule about ¼″ in diameter, ripening in April.

Distribution and habitat—The species is rare and has only been mentioned owing to its frequent occurrence in the damp valleys of the Puri Mals, where it is a menace to sal regeneration. It is rarely found in Singhbhum, Mayurbhanj and Angul and then only in deep cool valleys in association with evergreen species. In Tamna block, Puri, it occurs in forest where the main canopy was sal but where fire-protection has led to an increase in evergreen species. including this weed. Its growth is very rapid and the wood soft. The tree rarely attains a girth of 3ft.

24. MALLOTUS PHILIPPINENSIS

Local names—Gundi, kamlagundi (Oriya) ; Sendrungi (Kondh)

General description—A small evergreen tree with a short bole which is often fluted. It rarely exceeds 4 ft. in girth or 25ft. in height. As a rule it is much branched. Bark, thin, grey, red when blazed. It flowers in pale yellow spikes in October-November. The fruits ripen in February-March. The fruits consists of 3-lobed capsules covered with red glands ¼″-½″ in diameter.

Distribution and habitat—Found throughout the province but is more common in Orissa, especially in Puri district, Nayagarh and Daspalla states. It prefers a moist soil.

Silvicultural characteristics—Bears considerable shade. Coppices well and reproduces from root-suckers. It is frost-hardy and resistant to drought ; nor is it browsed by goats. A very hadry species.

The tree is silviculturally important as a nurse to sal and other species and is useful in the undergrowth owing to it ssoil-improving capacity.

Reproduction—The seeds do not long retain their power of germination. Seedlings require a moist soil and partial shades. Transplants can be put out in the first (or second) rains and this should be done with field crops to afford the necessary shade.

The growth is comparatively slow.

Uses—The wood is grey to light red in colour, close-grained. There is no heartwood. It is of little use as timber but is a useful fuel. The bark is occasionally used for tanning. Its chief importance lies in the red powder, obtained from the glands on the fruir which is used extensively for dyeing silks an orange colour. It is also employed as a medicine.

25. BRIDELIA RETUSA

Local names—Kasi, kosai (Oriya) ; kaka (Ho) ; kadrupala (Santali) ; khais (Sambalpur) ; ruhutu (Kondh).

General description—A moderate-sized or large deciduous (occasionally evergreen) tree, attaining 5 feet in girth with stiff, elliptic-oblong leaves, often with small pale brown spots. The tree has a grey, flaky, rather thick bark. Young trees have the stem covered in stout thorns about one inch long. The flowers are small and green, and appear in clusters in August—October. Fruit, yellowish berries, about ¼″ in diameter from November to January.

Distribution and habitat—Throughout the province usually near streams or on the cool sides of hills in the drier districts. It is commonly found in mixed forests but also with sal, being one of the more valuable of the miscellaneous species.

Silvicultural characteristics—The tree will stand moderate but not heavy shade. It resists fire, frost and drought well. It coppices readily and gives root-suckers. It has a strong tap-root. The rate of growth is rather similar to sal, the growth of coppice shoots being rapid ; 19 feet in height and about 7½″ in girth in 16 years.

Reproduction—The tree reproduces well naturally, given favourable conditions, the seeds being disseminated by green pigeons, parrots and other birds. It can be raised most successfully in a nursery, the seed being sown in March. Care is necessary in transplanting owing to the long tap-root, especially, if transplanted in the second rains.

Uses—The heartwood is dark brown streaked with black It is hard, fairly heavy, close-grained and durable, the weight being approximately the same as sal. It seasons well. It is used for house building and agricultural implements. "It stands well under water" (Gamble). The leaves are used for buffalo fodder and trees are often lopped for this purpose. The bark is used for tanning. The fruit is edible.

26. CLEISTANTHUS COLLINUS

Local names—Karla, karada (Oriya) ; karla (Hindi) ; parasu (Mundari) ; pasu (Ho) ; karadang (Kondh).

General description—A small, rarely a moderate-sized deciduous tree, occasionally reaching 3 feet but usually less than 18″ in girth. It seldom exceeds 20ft. in height ; with a very rough, blackish bark. The leaves are orbicular (round) or obovate, 1″—4″ long. The small green flowers appear in April-May and the fruit (¾″—1″ in diameter) ripens in March-April of the following year. The fruit is round, woody and brown when ripe. The tree is leafless in March-April. The blaze is red.

Distribution and habitat—Common in Orissa where it is often the chief species found in poor hill forest and also on clay soils. More commonly associated with miscellaneous species (noticeably *dhaura* and *asan*) and less often met with in company with sal. It is rare in good quality sal forests. On dry hill-sides it is often practically gregarious.

Silvicultural characteristics—A very hardy tree which survives fire and grazing well. Cattle do not eat it ; it is said to be poisonous. It coppices extremely well but the shoots are very numerous and require thinning to assist development of slected stems. It produces root-suckers.

The recorded rate of growth of coppice in Saitba block, Kolhan division, is 22ft. in height and 8½″ in girth in 14 years.

It can be raised successfully by direct sowing.

Uses—The wood is dark reddish-brown, tough, close-grained and heavy. It closely resembles *puijam* (*Eugenia operculata*) in appearance. It is highly prized for house-posts and rafters as it resists the attacks of white-ants. Poles of 18—24″ girth are most in demand, as they are split from end to end and then used as rafters. In the poorest dwellings the walls are often made of karla saplings and brushwood and the roof of the same material with thatch over it.

This is a tree of great utility which should be encouraged in coppice forest. The poles are often crooked, but if kept thinned to the correct density it can be grown quite straight.

The bark contains tannin. The fruits are used to poison fish.

27. EMBLICA OFFICINALIS

Local names—Anula, aunra (Oriya) ; aunla, amal, amlika (Hindi, Bengli); miral (Ho, Mundari, Santali) ; jhurka, jura, jurga, urangi (Kondh). The Emblic Myrabolam.

General description—A small or moderate-sized deciduous tree rarely attaining 30″ in girth, with light coloured bark and feathery, light green foliage. The old bark peels off in strips. Leaves, very small and narrow. Flowers, yellowish, on the new shoots. Fruit, globose, yellow or pink when ripe and about ¾″ in diameter. It flowers from February to May and the fruits ripen from October to April.

Distribution and habitat—Common throughout the area in all situations, but is undoubtedly more common in dry mixed forests. Very noticeable in the dry open forests of Sambalpur and Patna.

Silvicultural characteristics—The tree is a strong light-demander and is susceptible to both drought and frost. It is not in frequently found suppressed in the undergrowth under only moderate shade in mixed forest. It coppices very well but the stools should be cut low, otherwise the shoots are produced from above the ground. The rate of growth is rapid, a height of 37 feet and a girth of 26½″ being obtained in 16 years from seed sown in Chaibassa. This must have been under very favourable conditions, for coppice growth recorded in Gorakhpur only shows a height of 13¼ft. and a girth of 5½″ in the same period. This, on the other hand, appears slow and the average probably lies between the two.

Reproduction—The best results are obtained by transplanting seedlings from the nursery, as germination is uncertain. Care is necessary as the seedlings are sensitive.

Uses—The wood is red, hard, heavy and close-grained. It splits and warps easily. It is nevertheless used considerably for building small houses and for agricultural implements, where better material is not available. It yields a good fuel and charcoal and is durable under water.

The fruit is used in tanning but is inferior in quality. It is used as medicine and in preserves (chutneys). The raw fruit is a good thirst quencher. The twig bark yields an excellent tanning material.

28. GLOCHIDION LANCEOLARIUM

Local names—Kalchua (Oriya) ; bania-kandhum (Santali) ; sekar (Ho).

General description—A small evergreen tree with dark green coriaceous, shining leaves, elliptic or oblanceolate, 3—6″ long. Male flowers, small, yellowish, in clusters ; female flowers, small and greenish. Flowers, March to May. Fruit, a capsule, about ½″ in diameter. Bark, smooth, grey with a pink blaze, red on the wood.

Distribution and habitat—Common in Orissa, especially towards Puri where it is abundant and is one of the commonest species in the semi-evergreen forests. The wood is reddish-grown, moderately hard and heavy. It is only used as fuel. The tree appears to suffer little from grazing by cattle or goats. It coppices well and thrives even on the dry laterite and sandstone of Khurda. The seeds are said to give an oil used for burning.

29. PUTRANJIVA ROXBURGHI

Local names—Poichandia (Oriya) ; pitonj (Santali)

General description—A moderate-sized, rarely a large, evergreen tree with drooping branches. Leaves, glossy, with wavy margins, lanceolate 1″—3½″ long. Bark, grey, rather smooth, green inside male flowers, numerous, very small and yellow, in axillary heads or short spikes ; female flowers, green and solitary. Flowering season, March-April. The fruit is an ellipsoid or almost globose drupe about ½″ long and grey in colour. It ripens in February-March of the following year. The fruit stone is very hard and plae yellow in colour.

Distribution and habitat—Not in frequently planted. Common wild in the Mals of Puri and Ranpur state, and in damp localities elsewhere in Orissa in evergreen forest.

Silvicultural characteristics—The tree stands moderate shade and is easily killed by frost or drought. It can be raised artificially without much difficulty either by direct sowing or by transplanting, care being taken not to injure the tap-root during the latter operation.

Uses—The stones of the fruit are strung into rosaries. The wood is grey in colour, moderately hard, heavy and close-grained. It is not much used in our area, but is said to be suitable for turnery. The leaves are said to be suitable for fodder.

30. BISCHOFIA JAVANICA

Local names—Hajam (Mundari) ; pader (Santali)

General description—A moderate-sized evergreen tree with a dark-brown bark, flaking when old. Blaze pink with crimson juice, then whitish. Leaves, trifoliate, dark green and shining. Leaflets, 3″—6″ long, oblong, or obovate, strongly nerved. The minute flowers appear in panicles in March-April. The fruit is a small black berry, ¼″ in diameter.

Distribution and habitat—"Not common, but occurring throughout the province along streams." (Haines.) The tree bears moderate shade and only grows in moist localities. It coppieces well.

Uses—The timber is excellent, reddish in colour, hard, heavy and very durable, especially under water. It is suitable for numerous purposes but is rarely used in our Province. Haines says that it is very good for planking.

31. EUPHORBIA NIVULIA

Local names—Siju, badsiju (Oriya) ; etke (Mundari, Ho, Santali) ; thua (Sambalpur).

General description—A small stout tree 10—30 ft. high with a straight trunk and stiff whorled branches covered in thorns. The leaves are 6″—9″ long and fleshy. The leaves, branches and trunk exude a white milky juice when cut. It flowers in February—April and fruits in April. The wood is white when freshly cut, shoft and useless. It grows from cuttings.

Distribution and habitat—Common on dry rocky hills. Very plentiful in scrub jungle in Athgarh, Cuttack and Puri.

RUTACEŒ

32. LIMONIA ACIDISSIMA

Local names—Bhenta (Oriya) beli (Hindi)

General description—A small straight thorny tree rarely exceeding 30 ft. in height, with pinnate leaves (5—7 leaflets) and a winged petiole. Leaflets 1″-2″ long. Small white or yellowish flowers in May-June. The fruits are small, globose, black and very bitter: about ½″ in diameter.

Distribution and habitat—Common in Orissa especially in the drier parts and on laterite in Puri. Very common in the undergrowth in parts of Angul.

Silvicultural characteristics—A light-demander. Coppices well

Uses—Wood, yellowish-white, very hard, heavy and tough. It is used for cart-axles, oil-presses and rice-pounders, and is a good fuel. It should make a good substitute for boxwood. The fruit is said to be used in medicine.

33. FERRONIA ELEPHANTUM

Local names—Koitho (Oriya); kat-bel, koch-bel (Bengali Santali); kaith (Hindi).

General description—A moderate-sized or large thorny evergreen tree with dark green odd-pinnate leaves about 3″ long, Bark. Dark grey, almost black in old trees and rough. The tree sometimes attains 5½ft. in girth but rarely exceeds 30ft. in height. Flowers, green or reddish about ½″ in diameter in February to April. Fruit, 2½″-3″ in ~~diameter with~~ a rough woody rind.

Distribution and habitat—Planted throughout the province. Very common in parts of lower Orissa (Angul, Daspalla, Nayagarh, Banki and Puri) on waste land. It is possibly indigenous in this locality although not a forest tree. Frequent on black-cotton soil.

Uses—The wood is yellowish or greish-white, hard, heavy and tough. It is used for agricultural implements but not extensively on account of the fruit, which is used in much the same way as *bel*, in preserves. It yields a gum simiiar to "gum arabic," which is also given in cases of diarrhoea and dysentery.

34. AEGLE MARMELOS

Local names—Bel, (Hindi, Oriya) lohagasi (Ho, Mundari) ; sinjo (Santali). *bela* (Kondh)

General description—A small or moderate-sized thorny tree, rarely exceeding 40ft. in height. It is deciduous for a very short time in May. The bark is light grey in colour and corky on the outside. The leaves are trifoliate: leaflets 1″—2 ½″ long. Flowers, 1″ in diameter, greenish-white, appearing in May-June ; the globose or oval fruits are about 3″ to 4″ in diameter and ripen in the following May-June. The fruit has a hard, woody rind surrounding a yellow pulp, which contains the seeds. The leaves are sacred to Siva and are used in religious ceremonies.

Distribution and habitat—Throughout the Province. Commonly cultivated, when the fruits attain a much larger size than in the wild state. Most frequently found in dry mixed forest and very rarely (if at all) in good sal forest. Common in Angul

Silvicultural characteristics—The tree has a great capacity for growing under most unfavourable conditions owing to the abundant root-suckers it produces. It coppices fairly well but does not reproduce very satisfactorily from seed, as the seeds are eaten by white-ants. It is frost-hardy and withstands drought well. The root system is not deep. The rate of growth is extremely slow.

Uses—The timber is yellowish or greish-white, hard, heavy and tough. Although a usefull wood, is little used as it is secondary in value by comparison with the fruits. It is suitable for such purposes as oil-presses, sugar-mills, naves of wheels and agricultural implements.

The fruit is prized for making *sharbat* and chutneys and is extensively used as a cure for diarrheoa and dysentery.

SIMARUBACEÆ

35. AILANTHUS EXCELSA

Local names—Mahalimbo, mahanim (Oriya) ; maharukh (Hindi).

General description—A large deciduous tree with branches frequently in whorls. The bark is light-grey in colour. The leaves are pinnate, 2-3ft. long, with 10—15 pairs of coarsely toothed leaflets, which fall in April-May. Panicles of yellowish flowers appear from January to March: fruit, in May. New leaves from April to June. The red seed is winged, 2″-3″ long and is distributed by tne wind.

Distribution and habitat—Very common in lower Orissa, generally in village jungle. Not generally common in good forest. Frequently planted near villages.

Silvicultural characteristics—The tree is a light-demander and coppices well. It also produces root-suckers. The rate of growth is very rapid ; seed sown at Dehra Dun produced plants 14 ft. high and 12½″ in girth at the end of the fourth season.

Reproduction—Natural reproduction is not good but plants can easily be raised from seeds or cuttings.

Uses—The wood is white, soft and light, and is not durable. It is used for light boats in Madras and for rough packing cases It has been tried for match splints but the results were not very satisfactory. The wood tends to lose its white colour and turns grey on exposure.

BURSERACEÆ

36. GARUGA PINNATA

Local names—Jiga, kekar (Hindi); armu, (Ho, Mundari); kandwer (Santali); kenkar (West Orissa); mohi, sompotri (Oriya).

General description—A large deciduous tree with compound pinnate leaves 12″—18″ long, having 8—16 pairs of leaflets about 4½″ long and often covered in red galls. The bark is thick, smooth, soft, greyish-brown (red inside) and flaky. The leaves fall in March and are renewed in May-June, turning red before falling. Panicles of small yellow flowers appear at the end of the leafless branches in March—April. The fruit is yellowish-green, globose and about ¾″ in diameter; it ripens from June to August.

Distribution and habitat—Throughout the province, chiefly in valleys or on the cool sides of hills. Commonly found in mixed deciduous forest but also accompanying sal. It is not very exacting as to soil, but is not usually found in the drier and poorer localities.

Silvicultural Characteristics—The tree is a strong light-demander and is intolerant of shade. It is forst-tender but recovers well. It is susceptible to drought. It resists fire and would be a good species for reafforesting grassy blanks in damp localities. It coppices well, produces root-suckers and can be grown from cuttings. The rate of growth is fast, coppice shoots reaching a height of over 30 feet in ten years (*c. f.* Troup).

Reproduction—It reproduces well naturally, provided there is abundant light. It can be transplanted easily but direct sowings give better results.

Uses—The sapwood is white and large; the heartwood reddish, moderately hard and even-grained. The timber is little used but the heartwood of large trees should prove very suitable for furniture. It is a bad fuel.

The bark is used for tanning and the fruits are occasionally eaten. It yields a clear gum of no value.

37. BURSERA SERRATA

Local names—Raj-mohi, nembura-mai, hendura, limbura (Oriya); Kandior, kariar (Ho, Mundari); Armu (Santali);

General description—A moderate-sized or large almost evergreen tree with pinnate leaves 6″—12″ long; leaflets 3—4 pairs, 3″—5½″ long, more or less serrate. The bark is dark grey and slightly cracked; blaze, deep brown, then pink. The very, small green flowers are borne in panicles from the leaf axils in April. The fruits is globose, red when ripe, about ½″—⅓″ in diameter, and ripens in May.

Distribution and habitat—Throughout the province but more common in the southern area, especially in Angul, Puri, Athmallik and the adjacent areas. Generally more frequent in valleys, but is found on hillsides if they are not too hot and dry. Rare in Sambalpur.

Silvicultural characteristics—A moderate shade-bearer; "Coppices from the cambium ring.;" (Troup)

Uses—The timber is hard, with a light-brown sapwood and a red close-grained heartwood. It is moderately heavy and although it is not much used it is undoubtedly suitable for furniture and agricultural implements. Where it occurs most abundantly there are numerous other more useful species; hence its value is not appreciated. Recommended for furniture.

38. BOSWELLIA SERRATA

Local names—Salga, salai, sali (Hindi); salia (Oriya); salga (Ho, etc.); sarale (kondh).

General description—A moderate-sized or large deciduous tree, 4—6 ft. in girth and 30—50 ft. high with greenish-yellow or yellowish flaky bark. The leaves are pinnate, 12″—18″ long, with 9—16 pairs of leaflets 1½″—3″ long and distinctly serrate. The small whitish flowers appear in racemes at the ends of the branches from January to March when the tree is bare of leaves. The fruit is about ½″ in diameter and ripens in May-June. The tree is leafless from January to May or June, the leaves turning yellow before falling.

Distribution and habitat—Throughout the province on the hottest and most exposed stony aspects and hilltops. Not common in lower Orissa; but frequent in Gangpur, Sambalpur, Patna and Kalahandi, in the west of Baudh and the north of Angul. It is entirely absent from damp forest.

It is usually associated with such species as *Anogeissus latifolia, Lannea grandis, Sterculia urens* and *Cochlospermum gossypium.*

Silvicultural characteristics—A strong light-demander. It is a very hardy species, resisting fire and drought well. It coppices freely if the trees are not too big. It produces root-suckers and can be grown from cuttings. The rate of growth from coppice is rapid. Saplings are frequently damaged by deer rubbing the velvet from their horns.

Reproduction—Natural reproduction is usually good, both from seeds and root-suckers. Artificial reproduction requires protection from pig, as they eat the seeds. It can be grown very easily from quite large cuttings, which are often planted as fences in villages owing to the case with which they take root and sprout, even on dry soils.

Uses—Wood, moderately hard. Sapwood, white and large; heartwood, small, dark greenish-brown. The timber is not very heavy and is little used, although good pieces are fairly durable under cover and could be used as planks, shelves, etc. Selected pieces of heartwood have a fairly good appearance. It can be used for rough packing cases. It is not a bad fuel, though rather smoky, burning readily and having a pleasant smell. The charcoal is said to be used locally for gunpowder. It is utilized in the manufacture of match-splints and for packing cases after being kiln-seasoned.

The tree, when wounded, yields a resin (gum-oleo-resin), which is used as incense (*lohan*) and which gives a good quality turpentine, but the cost of collection is an adverse factor in is development on a commercial scale. The gum is used as medicine.

It is a difficult tree to kill by girdling. The leaves are hung up in cattle sheds to keep away flies in the same way as *nim.*

MELIACEÆ

39. CHLOROXYLON SWIETENIA

Local names—Bheru, bherua (Oriya); sengal-səli (Ho, Mundari, Santali); bhira (Hindi); Satinwood.

General description—A small or medium-sized deciduous tree rarely attaining 4 ft. in girth, except in Betla Block, Palamau, where it reaches 5½ ft. The bark is light grey in colour, thick and corky. The bole is generally short and crooked and the crown spreading. The leaves are pinnate, greyish green in colour and have a feathery appearance. The small white flowers appear in panicles in March-April, and the winged seeds ripen May—August. The seeds are contained in capsules 1″— 1½″ long. It is leafless from February---May.

Distribution and habitat—Throughout Orissa in the drier localities and often on the poorest soils. It is not common in Puri. Frequently occurs on lime soils, but is of small size. Rarely exceeds 3 feet girth. Small trees are fairly common in some of the drier forests of Angul, notably in some of the overcut and over-grazed protected forests near Purnagarh. Very common on sandstone and shale west of the Mahanadi in Sambalpur district.

Silvicultural characteristics—Satinwood is a strong light-demander although the seedlings require protection from the sun. It is frost-tender. It is liable to damage from fire but has a strong power of recovery. It coppices abundantly. Moreover it is not grazed and for these reasons it is one of the trees that survives best in overworked and over-grazed village forests. The soft bark of the tree attracts deer, which rub their antlers to remove the velvet, and in this way damage the stem. Young saplings are much damaged from this cause.

The tree reproduces well naturally and can be easily raised from direct sowings, provided weeding is carried out. Transplanting is also successful if soil is kept round the roots.

The rate of growth is slow.

Uses—The wood is yellow or cream-coloured, very hard and durable and has a satiny lustre. It is in demand in Europe for furniture and cabinet work. It is used for building and agricultural implements, yields good fuel and charcoal. In Palamau ploughs are made from the timber. It is fairly elastic and can be used for axe handles.

40. CEDRELA TOONA

Local names- Mahanim (Oriya); Tun (Hindi); katangai, roronga (Ho); ratangari (Mundari); dharni kapat, rudu (Kondh).

General description—A moderate sized or large deciduous tree attaining a girth of over 7 ft. with a spreading crown and large pinnate leaves 1— 2½ ft. long. The bark is greay, red inside, and scaly in old trees. The flowers appear in March—April; fruit June—July It is leafless in December—February but carries its shady foliage through the not weather and is thus a useful tree for roadside planting.

Distribution and habitat – Found throughout the province but generally only in shady valleys in the hills and never far from a copious water-supply. Fairly common in Bonai and south Kalahandi but nowhere very common. It often associated with *champa* (*Michelia champaca*) in cool ravines at the higher elevations in south Kalahandi, Mayurbhanj, Bonai and Saranda. Does not occur naturally in the dry forests of Orissa although occasionally planted.

Silvicultural characteristics – The toon is a moderate light-demander, but stands shade well in youth, young plants requiring protection from the sun. It is frost hardy, but tender in respect of fire and drought. It is liable to damage by deer and cattle in the seedling and sapling stages, and the shoots and fruits are attacked by a boring insect. The tree develops best on a deep moist loamy soil, but can be raised in dry localities provided it is watered when young.

Natural reproduction does not appear to be very good although seed is produced abundantly. Artificially the best results have been achieved by transplanting seedlings from the nursery in the second rains, after pruning the roots and stems.

The growth is rapid, records from Saharanpur showing a height of 34 ft and a girth of 31″ in 16 years.

Uses —The wood is red, soft and evengrained. It seasons well and does not warp or split. It has a pleasant smell. It is durable, is not eaten by white-ants and is highly valued for furniture of all kinds It is much in demands for cigar boxes. The leaves are used for cattle fodder and the flowers yield a red and yellow dye. The wood could probably be used for making pencils.

41 SOYMIDA FEBRIFUGA

Local names – Suam, rohini (Oriya): rohan, rohana (Hindi);

General description – A small to moderate-sized, rarely large deciduous tree with short bole and a thick dark greyish-brown bark exfoliating in flakes and strips. Leaves pinnate 9″—18″ long. White flowers in terminal panicles in February-March. The large ovoid fruit, 3″ long, ripens in May-June. The tree is leafless from March—May.

Distribution and hatitat— Not very common in Puri but is of frequent occurrence in the drier parts of Angul, Sambalpur and most of the northern and western districts of Orissa. It is one of the characteristic trees on lime soil and is found on black-cotton soil. It is usually a small tree with a short crooked bole, up to 3 ft. in girth but a few rate specimens of over 5 ft. girth have been seen Rather local, common associates are *Chloroxylon swietenia*, *Acacia catechu*, *Accia leucophloea*, *Zizyphus xylophyra*, *Emblica officinalis* and others.

Silvicultural characteristics—The tree is a light demander, coppices well and produces root-suckers. It stands fire and drought well but is somewhat frost-tender.

The tree can be raised more successfully by direct sowing than by transplanting seedlings from a nursery. The ground should be well drained and the plants kept well weeded.

The rate of growth is slow.

Uses—The wood is reddish brown, very heavy (74 lbs. per cft.); very hard and durable. It is difficult to season and is very liable to split. The wood has a very pretty silver grain with a satiny lustre and would make excellent furniture if thoroughly seasoned. It is used for construction but mainly for agricultural implements and oil-mills.

The bark is bitter and is used for diarrhoea. It also yields a tanning material and strong rope fibre. It gives a clear gum.

42. AZADIRACHTA INDICA

Local names—Nim (Hindi); limbo (Oriya); limbe (Kondh).

General description—A moderate-sized to large, usually evergreen, tree with rounded crown and pinnate leaves. The bark is dark grey, furrowed, moderately thick and red inside. The tree is practically evergreen except in very dry localities (viz., Sambalpur). Panicles of samall white flowers appear from March to May and the fruit ripens from June to August.

Distribution and habitat—Is probably nowhere indigenous in the province, although much planted and frequently found as if wild in jungle adjacent to villages. A useful roadside tree. It will grow on most soils however dry and does well on black cotton soil.

Silvicultural characteristics—The *nim* is a light-demander. It is forst-tender but stands drought well. It coppices freely and produces root-suckers. It is intolerant of over-much moisture in the soil. It is not readily browsed by cattle and goats; but the leaves are a suitable fodder for camels.

The tree reproduces well naturally. It can also be raised easily in a nursery and transplanted, although direct sowing gives better results. The seed should be sown as soon as possible after collection.

Growth is fairly rapid.

Uses—The heartwood is red, hard, close-grained, durable, scented and much resembles mahogany. It does not appear to be much used in Orissa (possibly because the tree is held sacred), but elsewhere it is used for making carts, agricultural implements and furniture. The bark is bitter and is used as a remedy for fever. The fruit yields an oil which is used for burning and in skin diseases. The leaves are used in making poultices and to keep away insects. The gum is clear and is used medicinally. The twigs are used for tooth brushed.

The idols in Jagannath temple at Puri are made of this wood.

43. MELIA COMPOSITA

Local names—Batara (Oriya).

General description—A very large deciduous tree with a spreading crown and a short bole often 6—7 ft. in girth. The leaves are compound, up to $2\frac{1}{2}$ ft. long and clustered at the ends of the branches. Bark, reddish-borwn, smooth in young trees, slightly cracked and flaky in old; blaze, thin, crimson, then white. Flowers, white, $\frac{1}{2}''$ in diameter, in panicles 5″—8″ long during February and March. The fruit is a drupe about 1″ long.

Distribution and habitat—The tree is only found in moist forests in south-east Orissa. It is fairly common in Angul and Puri. The growth is rapid. It can be grown without much difficulty from seed, provided the soil is kept moist.

Uses—The sapwood is greyish and soft; the heartwood is reddish-white, light, soft and not durable. It is not known to be used in our province, but might be suitable for rough packing cases, owing to its rapid growth and the case with which it can be grown, the merits of this light, soft wood, deserve to be more fully investigated.

Melia azedarach—(Bakain, the the Perisian Lilac)

A medium-sized deciduous tree, with a greyish-brown fissured bark and large compound leaves. The handsome purple flowers appear in May-June. The fruit is a yellowish drupe about $\frac{3}{4}''$ long. It does not occur naturally in our area but is occasionally planted in gardens. It is grown extensively in plantations in the Punjab for fuel, etc., on account of its rapid growth. It can be easily raised from seed direct or by transplants.

The sapwood is white; the heartwood red. The latter is soft and light but is fairly durable when seasoned and can be used for furniture and domestic work. The stones of the fruit are utilized as beads and the leaves and fruit are said to be used in medicine.

CELASTRACEAEÆ

44. ELAEODENDRON GLAUCUM

Local names—Chauli (Oriya); miri (Ho); niuri (Santali); jamrasi (Hindi).

General description—A small, rarely a medium-sized, almost ever-green tree, with a thin, grey, almost smooth bark; blaze, hard, with a dark red outer layer, then whitish, reddish on the wood. It exudes a watery sap when cut. Leaves, dark green, shining ovate, with a wavy (crenate) margin, about 4″—6″ long. Flowers, small. greenish-white or brown, in small cymes, 2″—4″ long from Septemeber to December. The fruit is an ovoid drupe about $\frac{1}{2}$″ long. The tree very rarely attains 4 ft. in girth in Angul but is usually less than 2 ft.

Distribution and hatbitat—Throughout the province; fairly common in mixed deciduous forsts, more rarely in sal forests. It is not infrequently found on a clay soil.

Silvicultural characteristics—The tree is a moderate shade-bearer and is frost-hardy. It produces root-suckers, but coppices only moderately well. The rate of growth is slow. It is somewhat difficult to raise artificially, but this can be done by using transplants.

Uses—The heartwood is reddish or pinkish when fresh, turning pinkish brown on exposure. It is moderately hard, heavy, even and close-gained. It seasons easily and works well and is a handsome timber suitable for furniture. It is not much used in our area.

RHAMNACEÆ

45. ZIZYPHUS JUJUBA

Local names—Borkuli (Oriya); ber, boyer (Hindi); Janumjan (Ho); dodari (Mundari); Jom-Janum (Santali); Buro (Sambalpur).

General description—A small to moderate-sized deciduous (almost evergreen) tree with a short bole, spreading rounded crown and drooping branches armed with recurved thorns. Bark, dark grey or almost black with long vertical fissures, reddish and fibrous inside. Rarely exceeds 3ft. girth in our province. Leaves ovate $1\frac{1}{2}$″ to 3″ long. The small greenish flowers appear in the axils of the leaves from April—October. The globose fruits ($\frac{3}{4}$″ long), orange or red when mature, ripen from October to March.

Distribution and habitat—Largely cultivated, but wild in some localities not very common in Orissa. It is often gregarious in grass lands as in Baudh State along the Mahanadi near Harbhanga, and does best on sandy or shingly alluvium and on arable lands . It is not, however, exacting as to soil and will grow in poor localities on a variety of soils.

Silvicultural characteristics—The tree is a light-demander, requiring full sunlight. It is extremely frost and drought-hardy and recovers well from injury by fire. It is browsed by goats and camels, but the dense prickly bushes provide a good protection for themselves and other species, enabling the latter (especially *simal* in grass lands) to become established. It coppices and pollards well and produces root-suckers.

The fruits are eaten by numerous birds and wild animals, the stones being passed with the excreta. Germination follows, but is often delayed. Given a loose soil it soon establishes itself.

Artificial reproduction can be accomplished either by direct sowing or by transplanting.

Growth is fairly rapid.

Uses—The wood is hard, reddish and moderately heavy. It is universally used for saddle-trees, agricultural implements and other purposes. It yields an excellent fuel and a first grade charcoal. It is a good lac host and is extensively cultivated in Manbhum district and elsewhere for this purpose.

46. ZIZYPHUS XYLOPHYRA

Local names—Ghontol (Oriya) ; ghont, kat-ber (Hindi) ; karkat, karkata (Ho, Santali) ; ghontul (Sambalpur); Kotodi (Kondh).

General description—A small, straggly, deciduous tree, often thorny but sometimes without prickles. Bark greyish-brown, smooth or rough with small exofoliating flakes. In general appearance rather like the *ber* but more straggly and not so bushy and compact. Leafless March to May. Small clusters of green flowers appear in April—June. Fruits ripen in January-February of the following year. The fruits are globose, 1—1 1/2″ in diameter and deep green when ripe.

Distribution and habitat—Common, especially in inferior dry forest on hills with a clay soil. It is sometimes almost gregarious occurring in association with such species as *Cleistanthus collinus*, *Emblica officinalis*, *dhaura*, *Acacia leucophloea*, etc.

Silvicultural characteristics—The tree is almost invariably found in open situations and is a light-demander but is capable of bearing slight shade. It suffers from frost but withstands drought and fire well. It is browsed by goats but has a strong power of recovery from injury. It coppices and pollards well. The tree reproduces fairly freely from seed in a natural condition provided shade is not excessive. Artificially the tree can be raised by transplanting pruned seedlings from the nursery in the second rains; or by means of direct sowings. Germination is often delayed until the second rains. The growth of seedling trees is slow but coppice shoots grow rapidly, being equal in height though slightly less in girth than *sal*.

Uses—The wood is reddish or yellowish-brown, hard and fairly heavy. It is mainly used for fuel and charcoal, but is also used for carts and agricultural implements. The fruits yield a very high prercentage of tanning ; the bark also being used for tanning. The kernels of the fruits are eaten. Lac is cultivated on this tree in parts of the Central Provinces (Damoh district).

SAPINDACEAE

47. SCHLEICHERA OLEOSA

(*Syn. Schleichera trijuga*)

Local names—Kusum (Hindi, Oriya) ; Kusumo (Oriya) ; Baru (Ho, Santali) ; Kohumu (Kondh);

General description—A large deciduous (almost evergreen) tree with a comparatively short bole and a handsome, dense-foliaged spreading crown. Leaves, pinnate with 2—4 pairs of leaflets. Bark, pale grey, red inside. The tree is very striking when in new leaf during March, the young leaves being red in colour. The tree attains a large girth (7 to 8 feet) but no great height. The greenish-yellow flowers appear in February-March ; the globose fruits ripen in July—August.

Distribution and habitat—Common in Orissa in the hilly parts. It is usually found in mixed deciduous forests of a dryish type but not uncommonly occurs in association with sal. Is perhaps most commonly met with near streams in dry type miscellaneous forest, where it reaches its best growth.

Silvicultural characteristics—The *kusum* is a shade-bearer and hardy as regards frost and drought. When young it is very apt to be damaged by grazing. Its coppicing power varies, and it produces root-suckers. Natural reproduction is good where the soil is loose and seeds soon become covered. It is noticeably good in parts of the south of Angul. Direct sowings in well-loosened soil, followed by frequent weeding, give better results than transplanting from the nursery.

The rate of growth of seedlings is comparatively slow; coppice growth being more rapid, at any rate during the first few years. On the whole it is slower than that of *sal* coppice.

Uses—The wood is light reddish-brown, very hard, tough, heavy and durable. It is not much used on account of the tree's value as a lac host, but is the best wood available for oil-mills and rice pounders. It is used for agricultural implements, seasons well, takes a good polish and yields excellent fuel and charcoal.
As a lac host, the *kusum* yields the finest quality of lac; and large spreading trees bear a very heavy crop. It is the principal lac host in Bonai, Keonjhar, Mayurbhanj, Gangpur and Kalahandi.

The fruit is eaten and the kernels yield a good quality cooking oil, which is frequently used for adulterating *ghi*. The leaves and twigs are lopped for cattle fodder. The oil is said to be the original Macassar hair oil.

ANACARDIACEAE

48. MANGIFERA INDICA

Local names—Ambo (Oriya); am (Hindi); uli (Ho, Mundari) maha, marka, maska (Kondh). The mango.

General description—A fine, large evergreen tree attaining 70 feet in height and 8 feet or more in girth with a typical rounded compact crown of dense deep-green foliage. The leaves are lanceolate and coriaceous (shiny). The bark is thick, dark greyish-brown, rough and scaly. The tree is of great importance as a fruit and shade tree but is not a common forest tree (except in Puri Division). The new leaves are a pale green or mauve and appear irregularly and often in patches among the old foliage. The heavily scented flowers appear yearly in January in Orissa and somewhat later in Chota Nagpur and Bihar. The fruits ripen from April to July. The wild fruits are 2″—4″ long, with a large stone and usually little flesh.

Distribution and habitat—The mango is certainly indigeous in damp, shady localities in most parts of the forest area of the Province, such as in deep ravines Bonai, in the Simlipal Hills of Mayurbhanj, in the Mals of Puri, the Kalahandi Hills and elsewhere. It prefers a deep, fertile, moist, well-drained loam, and under these conditions attain an immense size. It does not grow well in dry localities unless watered when young.

Silvicultural characteristics—The mango is a shade-bearer. It is skilled by abnormal drought or frost. Large trees withstand fire well. It is easily killed by girdling. The seeds germinate readily and soon establish themselves and develop if the soil is loose and shade is available. If exposed to the sun they die off rapidly. The mango can be easily raised from seed, direct sowing being preferable to transplanting, although the latter also succeeds. The best varieties of the cultivated mango are propagated by grafting.

Uses—The wood is soft and coarse-grained. In young trees it is white (but rapidly discolours unless very carefully dried) ; in old trees it is greyish and sometimes brown and hard. It is used for planking, packing cases and tea chests. The fruit is esteemed and in times of famine the kernels of the seeds are cooked and eaten, but are not considered healthy as they contain tannic acid.

49. BUCHANANIA LANZAN

(*Syn. Buchanania Latifolia*)

Local names—Char, charo (Oriya); Piar, pial (Hindi) ; tarub (Ho) ; Tarop (Santali) ; reka, serko, preko, (Kondh); the kernels of the stones are known as *chironji.*

General description—A small, sometimes moderate-sized deciduous tree, seldom exceeding 2 ft. in girth, with a straight trunk and a rough dark grey or black bark, slightly resembling crocodile hide. Blaze reddish. The tree sheds its leaves in April-May and renews them in June. The leaves are stiff and strongly nerved, 6″—10″ long, ovate-oblong. The small greenish white flowers appear in dense pyramidal panicles from January to March. The black ovoid fruits are about ½″ long and ripen in April-May.

Distribution and habita.—Common, especially in dry hill forests. Very common in the west of Orissa in Sambalpur, Gangpur, Patna, etc. It frequently occurs in eroded ravine land with a few other species such as *Soymida febrifuga*, and is also common on laterite soils. One of the common associates of sal in dry forest.

Silvicultural characteristcsi—The tree is a moderate light-demander, being tolerant of a fair amount of shade. It is very sensitive to frost, is fairly resistant to drought and suffers little from grazing. It avoids damp localities. Its coppicing power is poor. It produces root-suckers sparingly. A useful tree for covering bare hillsides.

Reproduction—Under favourable conditions natural reproduction is good but these conditions are rare in its habitat and as a result of drought and exposure, few seedlings survive:

Provided the seed is collected from the tree and not from the ground, good results can be obtained by direct sowings; this method giving better results than transplanting. The growth is slow.

Uses—The wood is greyish-brown, moderately hard, with a small dark heartwood. It is of poor quality and is not generally used, not even as fuel. A dark gum is yielded in some quantity but is not generally collected. The fruits are eaten and are collected for sale in parts of Chota Nagpur. The kernels (*chironji*) are edible and are widely used in the manufacture of sweetmeats.

50. SEMECARPUS ANACARDIUM

Local names—Balia (Oriya) ; Bhelua (Hindi) ; Bheluan (Sambalpur) ; Soso (Ho, Mundari); ganja, ganju, goanju (Kondh) The Marking Nut tree.

General description—A small or moderate-sized evergreen tree with rough dark-brown bark. It seldom exceeds 2 ft. in girth and usually has a low spreading crown. The large dark green obovate leaves are 8″—18″ long; they are strogngly nerved and clustered at the ends of the branches. The small greenish-yellow flowers appear from June to September. The fruit is an oblong or ovoid drupe 1″ long, black when ripe, seated in an orange-coloured cup. It ripens in December-March.

Distribution and habitat—Throughout the Province, being fairly frequent in the hills. It is more commonly found in dry than in damp localities in both *sal* and mixed deciduous forest.

Silvicultural characteristics—The tree is a moderate shade-bearer and coppices well. It is sensitive to frost but has a good power of recovery. It prefers dry localities but will grow in moderately damp positions. It bears fertile seed at a very early age.

Uses—The wood is greyish-brown and soft. It is not used owing to the black corrosive juice which exudes from the bark when cut and which causes blisters if it touches the skin.

The orange-coloured cup is eaten but the black seed (pericarp) is poisonous. .The black oily juice, which it contains, is used for marking cotton fabrics. It is also used in a preparation for "*chobing*" elephants' feet. The bark exudes a gum which is not known to be used.

51. LANNEA GRANDIS

(*Syn. Odina wodier*)

Local names—Mohi, mai (Oriya) ; Mode (Kondh) ; Jhingan (Hindi) ; Nanam (Ho) ; Doka (Santali) grabang (Kondh),

General description—A moderate-sized to large deciduous tree with a spreading crown. Compound pinnate leaves, 12"—18" long, ovate acuminate with an oblique base. The bark is light grey in colour and smooth. It is generally ½"—¾" thick an has a crimson blaze streaked with pink and white.

The leaves commence falling in November and the tree is generally leafless from December to early June. The small yellowish-green flowers appear in dense masses of feathery blossom at the ends of the branches in March-April. the fruit is a small, red, curved, oblong, drupe, ½" long, which ripens from May-July and is much eaten by birds.

Distribution and habitat—This is one of the commonest trees throughout the Province, in dry hilly forests. It is an associate of sal, but occurs rather more frequently in dry deciduous forest of a mixed character, often with bamboos. When occurring in moist localities it attains large dimensions.

Silvicultural characteristics—The tree is a strong light demander It is very fire-resistant but is tender to frost. The leaves and young shoots are eaten by cattle. It pollards well, produces root-suckers and generally coppices strongly. The coppice shoots grow very rapidly.

Reproduction—The tree grows well from seed or cuttings but the seed should be sown fresh as it soon loses its vitality.

Uses—The sapwood is large ; heartwood light red when freshly cut, turning reddish-brown on exposure. The heartwood of large trees is hard and close-grained and is said to be useful, but is seldom used in this Province. The pith and other tissues contain an abundance of starch ; hence, the branches are good fodder for elephants. It yields a gum which is used by weavers for cloth printing. The bark gives a coarse fibre. The fruit is largely eaten by birds.

52. SPOINDIAS MANGIFERA

Local names—Ambada (Oriya) ; Amra (Hindi, Santali): Amboamburu (Ho, Mundari) srena (Kondh).

General description—A large or medium-sized deciduous tree with stout branchlets and large compound imparipinnate leaves, 12″—18″ long, having a strong smell of mangoes. There are 4—6 pairs of leaflets 2″—9″ long by 1″—4″ broad. The tree is leafless from December to May or June. The small white flowers appear in large panicles 1″—2″ ft. long in February-March when the tree is leafless. The fruit—a large yellowish plum-like drupe, 1½″ long—ripens in the following January. The bark is pale grey in colour, thick and smooth and has a pink or light red blaze with streaks of lighter pink.

Distribution and habitat—The tree occurs throughout the Province in dry forests but is perhaps more frequent near streams. It is nowhere very abundant although widely distributed. It is fairly common as a small tree in some of the protected forests to the south of Angul town.

Silivicultural characteristics—The tree is a strong light-demander, is sensitive to forest but stands drought well. It coppies freely.

Reproduction—The fruit stones germinate in the rainy season following their ripening, and provided the seed-bed is satisfactory, the seedlings readily establish themselves. Abundant light is required for further development. Germination is sometimes delayed till the second monsoon.

The tree can be propagated readily from cuttings or from seed. In the latter case, direct sowings give better results than transplanting, provided the fruit stones are covered with earth. Growth in fairly rapid.

Uses—The wood is light grey in colour, soft and useless. A gum is obtained from the bark. The fruit is used in condiments and is much eaten by deer and other animals.

PAPILIONACEAE

53. OUGENIA DALBERGIOIDES

Local names—Bandhan (Oriya) ; sandan, panan (Hindi) ; ruta, panjin (Ho) ; rot (Santali) ; tinsa (W Sambalpur) ; jarung

General decscription.—Generally a small or moderate-sized deciduous tree seldom exceeding 4 ft. in girth and 30—40 ft. in height ; but under exceptionally favourable conditions attaining a girth of 6 ft. or even more (in Angul, Bamra, Narsinghpur) and a height of 60 ft. The bole is generally short and crooked and the crown is large in fully-developed trees. The bark is thin, ashy-grey or light-brown with regular longitudinal and horizontal cracks. Blaze closely streaked with blood-red on a white ground and exudes a red juice. The leaves are trifoiate; leaflets often slightly hairy beneath 3″—6″ long and rather variable in shape. The white or mauve flowers are borne in great profusion in February-March, the tree, presenting a very remarkable and beautiful sight. The tree is leafless in February-April and the pods ripen in May. They are 2″—4″ long and contain 2—5 seeds.

Distribution and habitat—Found throughout the Frovince. It occurs in association with sal but is most frequent in dry hilly mixed deciduous forest containing bamboos. it occasionally forms pure patches as in Katada block (N. aspect) Angul. It is nowhere abundant and large trees are rare but the following areas may be cited as containing rather above the average, in both quality and quantity : Angul generally, but Burti block especially; Bamra and Narsinghpur. Large trees were heavily exploited throughout Orissa between 1920 and 1930. Very rare in west Sambalpur.

Silvicultural characteristics—The tree requires shade when young and some protection from the sun in its earlier stages of development. Once established, it requires full overhead light. In early youth it is tender to frost and drought but later on it is hardy. It is much subject to browsing by cattle and deer. It coppices vigorously and produces abundant root-suckers. It is readily damaged by fire, especially in its earlier stages and responds to fire protection. Owing to its strong root system, the facility with which it produces root-suckers and the fact that it will grow on very poor soil, it is a useful tree for growing on hill slopes.

Reproduction—On bare loose soil regeneration is often prolific and the scarcity of this tree in our forests must be largely attributable to deer and fire, combined with drought in its early stages. Dense patches of seedlings are not infrequently met with.

The tree can be propagated artificially by "root and shoot cutting" or by direct sowings. Direct sowing in lines with field crops gives excellent results: using the little millet (*mandia*, *marua*) The rate of growth is slow, about half that of *sal*.

Uses—The sapwood is small ; the heartwood being light-brown or reddish-brown in colour. It is hard, close-grained, tough and extremely durable. In fact, when obtainable in large sizes it is among the first three timbers produced in the province for a variety of purposes. Unfortunately supplies are limited and well-grown timber of good size is very scarce. It is about the same weight as *sal*, or slightly lighter, easy to work, takes a good finish and has a good appearance. The wood is in large demand for agricultural implements and house-posts, but above all for wheel-work: the best naves being made of this wood. It is also used for shuttles in looms. Excellent furniture can be made from it, but it is somewhat heavy.

Lac is occasionally cultivated on this tree in Singhbhum district the shellac being of high grade.

The leaves being eaten by cattle, the branches are often lopped for this purpose.

The bark yields a rough fibre and a red transparent astringent gum. It is also sometimes pounded and used as a fish poison.

54. BUTEA MONOSPERMA

(*Syn. Butea foundosa*)

Local names—Palas, porasu (Oriya) ; phalsa (Sambalpur) ; dhak (Hindi) ; morud (Ho); murup (Santali) ; paras palas (Bengali); bodali mranu padel (Kondh) "flame of the forest".

General description—A small or moderate-sized, crooked deciduous tree with an open irregular crown and large trifoliate leaves. Bark moderately thick, fibrous, light-brown or grey, exuding a red juice when cut. Leaves 4″—8″ long and broad and greyish in appearance. Flowers, scarlet and orange, borne in great profusion on the leafless branches in February—April. The tree is very striking when in flower. The pod is about 6″ long, contains flat oval seeds about 1½″ long and ripens in May-July.

Distribution and habitat—Not a common forest tree, but plentiful in cultivated and waste lands in the most waterly in parts of Orissa, now particularly in Baudh, Sonepur, Patna and Khariar.

Silivicultural characteristics—Although it usually grows in exposed positions, the seedling can bear a certain amount of shade. It is frost-hardy, drought-resistant and free from browsing by cattle and goats, although it is said (Gamble) that the leaves are used as fodder for buffaloes. The tree coppices and pollards freely and produces root-suckers. The growth of coppice shoots is rapid but the girth increment of the tree is slow.

Reproduction—Natural reproduction of this tree is usually prolific owing to its immunity from grazing. It can be propagated artificially by direct sowing or by transplants, the former being the more successful and economical method. Pigs, porcupines and rats must be guarded against.

Uses—The wood is grey or grey-brown: white when freshly cut. It is light, soft, not durable and liable to discolour badly if not carefully seasoned. Although not normally durable when exposed to the air, it is fairly durable under water and is used for well-curbs and water scroops. The planks, if carefully seasoned, could be used for rough packing cases, but they are liable to insect attack and decay speedily. The charcoal is said to be used for manufacturing gunpowder.

The bark gives a coarse fibre used for cordage and for caulking boats. The leaves are used for plates. The bark also yields a red transparent gum used in medicine.

This tree is one of the most important lac hosts, although the quality of the shellac is not equal to that produced on the *kusum*. It is therefore extensively conserved on waste land and along the edges of fields for lac cultivation.

Butea superba—(Noi-palas; morud; nari-murup; dorang) is a very large woody climber found throughout Orissa more particularly in dry, mixed deciduous forest in the western districts. It is a common pest in sal forests. The leaves and flowers are similar in appearance to those of *Butea frondosa* but are considerabley larger. The trunk sometimes attains a girth of 2—3 ft.

55. DALBERGIA SISSU

Local names—Shisham (Hindi); Sissu.

General description—A large deciduous tree with a ligh crown; bark about ½″ thick, grey and longitudinally furrowed It attains a height of almost 100 ft. under favourable condition and a girth of 6—12 ft. Leaves compound with 3—5 (usually 5) alternate leaflets. Leaflets ovate, obovate, orbicular or acuminate, 1″—3″ long : partially deciduous from December —March. Flowers small, yellowish, in dense panicles 2″—3″ long in March—April with the new leaves. The strap-shaped pod is 1″—3″ long with 1—3 (rarely 4) seeds and ripens in November —December.

Distribution and habitat—Not indigenous in Orissa and not commonly planted. Although it will grow tolerably well under a variety of conditions it reaches its optimum on alluvial deposits of sand and shingle along rivers, when the banks are subjected to periodic inundation. It is after such floods that *sissu* springs up gregariously on the deposits left by the river in its natural habitat.

Extensive plantations of *sissu* have been made in norther. India, but only one has hitherto been made.in this province at Anandpur in Keonjhar State on arable land that was inundated by sand in 1927. The results to date are very promising.

Silvicultural characteristics—*Sissu* is a strong light-demande Heavy and early. Thinnings are therefore essential in dense crops. It is decidedly frost-hardy. Seedlings are rather susceptible to drought although in its natural state mature trees are distinctly resistant. *Sissu* plants must be protected against animals, as cattle, camels and goats are partial to the leaves. The tree is not very resistant to fire. It requires a porous well-aerated soil (preferably light) and will not tolerate clay. It is liable to certain fungus and insect attacks.

Sissu coppices vigorously and grows rapidly.

Reproduction—Under favourable conditions—a light porous soil and adequate moisture—natural regeneration is good, provided the growth of grass is not too dense. Dense weed growth completely prevents regeneration.

Sissu can be propagated from cuttings or root-cuttings, but it is more usual to raise it from seed. Direct sowings give excellent results. If it is necessary to have recourse to transplanting, root-and-shoot cuttings should be used. Weeding is absolutely indispensible. Futher details are given in Howard's "Forest Pocket book."

The rate of growth is very rapid in the case of coppice shoots, a mean height of 28 ft. being attained in eight years in Changa Manga (irrigated) plantation. A tree in the compound of the Manager of the Bettiah Raj estate and stated to be only 20 years old showed a girth of 8 ft. (*c. f.* Haines). Generally speaking the rate of growth is rapid up to middle age, when it slows down.

Uses—The heartwood is brown with dark longitudinal streaks; the sapwood being small and white. The timber is fairly heavy, very hard, close-grained, strong and durable. It seasons well and does not warp or split. It has a handsome grain and when polished makes excellent, though rather heavy, furniture. It is used chiefly for building, furniture, carts and carriages. Above all it is valued for wheel work and guncarriage wheels. It is an excellent fuel and yields a high grade of charcoal.

56. DALBERGIA LATIFOLIA

Local names—Sissu (Oriya); pahari sissu, sitsal (Hindi); kiri (Ho); satsayer, mahle (Santali); musu, nadi marnu (Kondh); Blackwood, Rosewood.

General description—Usually a small tree in the north and centre of the province but attains 6 feet in girth and more in parts of Orissa (especially Angul). The tree has a large rounded crown and is deciduous for a very short period only. The bark is fairly thin, grey, exfoliating in long thin flakes. Blaze green, then pale yellow. The leaves are compound with 5—7 unequalsized roundish leaflets. The flowers are small, pure white, in numerous panicles 2″—4″ long and appear in September when the tree is in full leaf. Pods, 1½″—3½″ long, stalked, with 1—3 seeds (rarely 4) ripening in January-February.

Distribution and habitat—Although it occurs throughout most of the province it is nowhere common. It is frequent in Orissa, especially in Angul and Athmallik but trees of more than 4 feet in girth are scarce, and 5 feet girth trees are rare. It is not commonly found in sal forests, being more frequently met with in dry mixed deciduous forests on hillsides often together with *bandhan* (*Ougeinia dalbergioides*) and *piasal* (*Pterocarpus marsupium*) and is almost invariably associated with bamboos (*Dendrocalamus strictus*) Really large specimens only occur on deep fertile soils, generally near valley bottoms on well-drained ground.

Silvicultural characteristics—*Sissu* is a moderate light-demander but stands a fair amount of shade in youth ; if grown in the open it becomes very branchy. It is rather frost-tender. Although mature trees are resistant to drought, seedlings are rather tender in this respect. Seedlings and saplings are browsed by cattle and goats, but where the growth of grass is heavy, grazing may be beneficial. The tree grows best on a deep well-drained moist soil but can survive on poor dry soils, where it is more commonly found in our area. It is distinctly fire-resisting.

The tree coppices well and also reproduces root-suckers. The rate of growth under natural conditions is not fast but better results can be obtained under artificial conditions in well-selected localities.

Reproduction—In areas protected from fire and grazing, where there is adequate light and a good germinating bed, natural reproduction is often moderately abundant provided drought is not excessive. On the whole, however, natural reproduction of *sissu* is rarely met with in any quantity in our forests.

The tree can be propagated artificially by cuttings, root-suckers, by direct sowing or transplanting from the nusery. Direct sowing generally gives the best results but " root-and-shoot cuttings " are also satisfactory. The greatest danger is from drought, but weeding and loosening of the soil are both essential to success. The tree can be conveniently raised with field crops in lines 12 feet apart.

Uses—The sapwood is small and yellow. The heartwood is dark purple with black streaks, hard, heavy, close-grained and durable. It is used for a variety of purposes, such as agricultural implements, furniture and ornamental work. It is a handsome timber. Its strength and elasticity render it one of the best timbers for wheel work. Unfortunately supplies are limited and large trees are scarce. It is greatly used for furniture-making in Cuttack.

Dalbergia lanceolaria (*Chakundi*, Oriya ; *Koiad*, *kiachalom*, Ho) – A small or moderate-sized tree occurring sparsely throughout the province. Very common in Baruni block, Puri. Very beautiful when in flower and covered with pink or mauve blossom. The wood is yellow, hard and durable, but trees of over 2 feet in girth are rare.

Dalbergia paniculata (Dhuben, Barabakulia, *Oriya* kechparla pechpenda *Kondh*)—A common tree occurring in Orissa only. Very common in the dry forests of west Orissa. The bark is very pale, grey or whitish. The tree reaches a girth of 4 to 5 feet but the wood is quite useless, even as fuel.

57. PTEROCARPUS MARSUPIUM

Local names—Bija (Oriya) ; piasal, bijasal, paisar (Hindi); Hid (Ho) ; Murga (Santali) ; bengesi (*Kondh*).

General description—A large deciduous, nearly evergreen, tree attaining 7—10 feet in girth and a height of 100 feet with a straight bole under favourable conditions. The lower part of the bole is often fluted in large trees. Bark about ½″ thick, exfoliating in small irregular flakes. Blaze grey streaked, then pink with fine lines exuding a red juice. Leaves compound, with 5—7 elliptic leaflets 3″—5″ long with rounded ends, bluish-grey beneath. The tree is leafless for a short period only in April-May. The panicles of sweet-scented yellow flowers appear in October at the end of the branchlets. The flat disc-shaped pod is 1″—1¾″ in diameter and ripens in December-January. It is winged and contains one or two seeds.

Distribution and habitat—Throughout Orissa, it is locally common, notably in parts of Baliguda Patna and Kalahandi. (A remarkable area of gregarious *bija* of very large size occurs in Kamkot block, Kalahandi). It is also very common on sandstone in the north of Angul but only reaches a small size. It is one of the more frequent associates of sal, but occurs more commonly in mixed deciduous forest with bamboos on the lower slopes of the hills near *nalas*, especially on northern aspects. It is only locally abundant and nowhere forms a large proportion of the crop. It is not exacting as to locality and reaches a larger size than most trees on exposed hillsides or shallow rocky soil.

Silvicultural characteristics—The tree is a moderate light-demander ; it can stand a fair amount of side shade, but is intolerant of direct overhead shade. Complete freedom overhead is necessary after it has reached the sapling stage. Young plants are frost-tender and the tree is somewhat susceptible to drought, in spite of the fact that it often grows in very dry positions. It coppices moderately and produces root-suckers sparingly. It is sometimes damaged by lopping for cattle fodder. It is reasonably fire-resistant except in the seedling and sapling stage.

Reproduction—Natural reproduction is fairly good, but if the seed-bed is not clean or on stiff clay, the radicle dries up before it can penetrate the soil. The chief obstacle to regeneration, however, is the damage done by deer and cattle in areas open to grazing. Protection from fire and grazing greatly assists reproduction.

For artificial reproduction it is necessary to assist germination by soaking the pods in water for some days. Direct sowing gives better results than transplanting. Plantations require careful protection against damage by fire, deer and cattle. The rate of growth is fairly rapid.

Uses—The sapwood is small in large trees but in trees of less than 4 feet in girth the heartwood is inconsiderable. The heartwood is yellowish-brown with darker streaks, hard, close-grained and durable with a good lustre. It seasons readily and is easy to work. It is used for a variety of purposes : agricultural implements, spokes and fellowes of wheels, etc., but is most in demand for planking and furniture. It takes a good polish and has a good appearance. Unfortunately it gives a yellow stain if in contact with water or moisture which necessitates a waterproof varnish in the case of furniture. The astringent gum (" kino ") is used medicinally. The leaves are often lopped for fodder for buffaloes. The bark is said to be of use for tanning leather but is inferior to other barks

58. PONGAMIA PINNATA

(Syn. *Pongamia glabra*)

Local names— Karanj (Hindi, Oriya, Santali) ; kiramal (Hindi).

General description—Sometimes a large, more usually a moderate-sized tree with a short bole and a spreading crown : almost evergreen. Bark thin, smooth and grey in colour. Blaze shows green (chlorophyll) under outer bark, then yellow. Leaves compound, 8″—14″ long with 5—7 oblong or ovate shining leaflets 2″—5″ long (occasionally up to 8″ long). Flowers, mauve, appearing in May-June. Pod woody, 1½″—2″ long, one-seeded, ripening in December—January. The tree is leafless for a very short period in May.

Distribution and habitat—Found throughout the province along streams and in the coastal forest. It attains a girth of 5 feet in the wild state. Common along rivers especially from Athmallik eastwards. Extensively planted as a roadside tree, for which purpose it is excellent ; for, although a small tree, its dense spreading crown gives good shade and has a good appearance. Furthermore, it is hardy and will thrive under very adverse conditions.

Silvicultural characteristics—The tree is a shade-bearer. Although it prefers damp localities, it can grow on very poor soil in hot dry situations. It will grow on black-cotton soil and sand. It is very resistant of drought and stands frost moderately well. It develops a large tap-root at an early age. The tree produces root-suckers.

Reproduction—*Karanj* is easily raised from seed, the seed retaining its vitality for at least a year. If sown in the nursery in April or May, it can be readily transplanted early in the rains of the next year. For forest purposes, direct sowing would prove more suitable.

Uses—The wood is white, turning yellow on exposure, moderately hard and fairly heavy. The timber is not durable and is readily eaten by insects but is improved by seasoning in water. It is not much used in this province, though said to be used for fuel and oil-mills in Bengal (Gamble).

The seeds yield a thick brown oil which is used for burning and as a cure for skin diseases. It is a good cure for mange in animals and a soap is prepared from it which is useful for this purpose. *Karanj* cake (*khalli*) is a good manure for roses, etc., and is said to keep off white-ants. The oil has a very unpleasant pungent odour.

The branches are lopped in south India and ploughed into the rice-fields as manure.

CÆSALPINACEÆ

59. CASSIA FISTULA

Local names—Sunari (Oriya) ; amaltas, sundaraj (Hindi); hari (Ho) ; mirju-baha, nuruc (Santali). *bahanga, bundheni, kundani nunded, punjilang* (Kondh). The Indian Laburnum.

General description—A moderate-sized deciduous tree with an open crown, very handsome when in flower. It seldom exceeds 2½ feet in girth. Bark thin, greenish-grey and smooth when young ; reddish-brown and rough when old, exfoliating in patches. Blaze rather hard, red-brown, slightly streaked. Leaves compound with 4 –8 leaflets in pairs. Leaflets ovatelanceolate 2″—7″ long. Flowers bright yellow in long drooping panicles. Pods dark-brown or black cylindrical, 1-2 ft. long and 1″ in diameter. Flowers May to August ; the pods fall in April. The tree is deciduous for a short time in March-April ; the young leaves are a delicate pale green or copper colour.

Distribution and habitat—Wild in all districts and commonly planted in gardens. It is found under varying conditions of soil and aspect and is nowhere very abundant, occurring with greater frequency in Puri than elsewhere. Young seedlings and coppice shoots are noticeably common in Angul and the neighbouring states, especially on fire-lines. On the whole it appears to be more common in forests of an open type.

Silvicultural characteristics—*Sunari* is a moderate shade-bearer frost-tender but decidedly drought-resistant. It is not readily browsed, not even by goats. It coppices very vigorously and produce root-suckers. The rate of growth of coppice shoots is rapid a first but soon slows down. One-year-old shoots frequently attain 6 feet in height. It develops a strong taproot at an early age.

Reproduction—Natural reproduction appears to be poor except where effected through the agency of animals, the pods being broken by jackals, monkeys, bears and pigs (and possibly other animals) and the seed thus liberated and scattered. This might account for the more abundant regeneration noticed in Angul, where game is certainly plentiful. These animals are known to eat the pulp of the pods. Moreover, some of the seeds are swallowed by the animals and voided by them, thus assisting germination. High mortality occurs where weed-growth is heavy. Much of the natural reproduction met with in the forest is from root-suckers.

Artificial reproduction is not very satisfactory owing to the uncertainty of germination, many seeds lying dormant for a year. Seeds kept for a year germinate more readily than fresh seed.

Uses—The sapwood is large. The heartwood varies in colour from grey to brick-red, being most commonly yellowish-red. It is very hard and durable and about the same weight as sal or slightly heavier. The wood although small, is useful for house-posts, carts, agricultural implements and rice pounders. It has a tendency to splinter and on the whole is not greatly used.

Its greatest importance lies in the value of its bark as a tanning reagent. It has a ready sale, and many areas have been over-exploited for the bark. Poles of 12″—18″ girth are most suitable. Thus a system of coppice on a short rotation is admirably suited for its management.

The pulp of the pod is a strong purgative and is much used in medicine.

60. CASSIA SIAMEA

Local name—Chakundi (Oriya) ; siris ; but neither name properly belongs to it.

General description—A small or moderate-seized, evergreen tree. Leaves 6″—9″ long with 6—14 pairs of oblong leaflets 1½″—2½″ long and numerous large erect panicles of bright yellow flowers. Pod flat, 6″—9″ with many seeds. Flowers September to December.

Distribution and habitat—Not indigenous but commonly planted and often self-sown, as for example along the roadside from Khurda to Cuttack.

Silvicultural characteristics—The tree is a strong light-demander and has a very rapid growth. It is, however, short-lived. At least moderately frost-hardy but clearly does best in a warm and fairly humid climate. It attains as much as 20 to 25 feet in three years.

Reproduction—Grows readily from seed and is not difficult to transplant. No information is available regarding root-and-shoot cuttings.

Uses—The heartwood is dark brown but the timber is not durable. However, it makes a good fuel and its rapid growth gives it a good claim to wider use in firewood plantations. The ease with which it can be grown from direct sowings also indicate that it could be used for reafforestation work, especially in forests set aside for village supply. As far as is known it is not browsed by cattle or goats.

61. BAUHINIA MALABARICA

Local names—Koteli (Oriya) ; ampti (Oriya, Hindi) ; laba (Ho) ; jhingit (Santali), koap roding (Kondh).

General description—A small deciduous tree attaining 4 ft. in girth with a bushy crown and dark green leaves 1″—4″ in diameter, broader than long, greyish beneath and acid to taste. Flowers dullish white in axillary racemes, 2″—3″ long. Pods 7″—12″ long by ¾″ broad, flattened and generally curved. The tree flowers in September—November. The pods split open on the trees in January—March. Bark, light brownish-grey, nearly smooth, with oblong flakes when old. The acid taste of the leaves may be used to distinguish this species from *B. racemosa*, which is very like it. The leaves are cleft for about one-third of their length.

Distribution and habitat—Throughout the province ; generally in moist localities and along streams in the drier districts. Common on northern slopes and along valleys. A common accessory species in sal forests. Perhaps less common in Orissa than in Bihar.

Silvicultural characteristics—The tree bears a moderate amount of shade. The seedling is frost-tender in early youth. The seed often lies dormant for a year and germinates in the second monsoon. The rate of growth is slow. It coppices well.

Uses—The wood is reddish-brown with dark patches near the centre. It is moderately hard but is only used as fuel, which is of good quality.

62. BAUHINIA VARIEGATA

Local names—Konchan (Oriya) ; Kachnar (Hindi) ; Buj, juruju, buruju (Ho) ; Jhinjir (Santali) ; Jantai (Mundari) ; Thoro (Bamra State) ; Lal-kangchan and vaga-kangchan (Bengali).

General description—A moderate-sized deciduous tree with leaves 2½″—6″ long by 3″—6½″ broad, 13—15 nerved, cleft about one-fourth to one-third the way down into rounded lobes, bluish-grey (glaucous) and slightly hairy (pubescent) beneath. Bark grey, with longitudinal cracks ; blaze pale pink. Flowers, large pure white, pink or purple with one yellow, petal, appearing in January—March. The pod is flat, 6″—12″ long by ¾″—1″ broad. They ripen in April-May when they split, for the most part on the tree, shedding their 10—15 seeds. The tree is leaf-less in March-April.

Distribution and habitat—On dry rocky hills. Cultivated in gardens in all districts for its beautiful flowers ; sometimes flowering in its second year as a shrub.

Reproduction—The tree grows readily from seed if watered and weeded and can be transplanted in the first rains. Watering is essential.

Uses—The wood is greyish-brown with darker patches near the centre and is moderately hard. It is only used as a fuel. The bark yields a fibre. The flowers and flower-buds are sometimes eaten.

63. BAUHINIA PURPUREA

Local names—Borda, kuliar (Oriya, Bamra) ; Sona (Hindi) ; Sing-a (Ho) ; Sinhara (Santali) ; Deva-kanchan (Bengali) ; Buruju ; cher, koap kucha (Kondh).

General description—A moderate-sized evergreen tree with a bushy crown ; leaves 9—11 nerved, 5″—7″ long, deeply cleft. Bark ashy or ashy-brown ; blaze with or without pink outer layer, then pale yellow, then white, but again yellow next to the wood. The large purple, fragrant flowers appear in terminal racemes from September to December. The pod is 6″—12″ long by ¾″—1″ narrow below, brodening upwards, flat splitting on the tree when ripe from January to March.

Distribution and habitat—Frequent in all districts in the valleys and cultivated in the villages. The tree is a moderate light-demander and is decidedly frost-hardy.

64. BAUHINIA RETUSA

Local names—Choari (Oriya) ; Laba (Ho); dundra panki (Kondh).

General description—A moderate-sized tree. The leaves, which are 7—11 nerved, are not so deeply cleft (emarginate) as in most other Buhinias, about 4″—7″ long, and rather broder than long. Flowers white, about 1″ in diameter, the three upper petals being mottled with purple. Pods straight 5″—7″ long by ¼″to ¾″ broad, thin and deep red until ripe. Flowers September-December ; fruit February-March.

Distribution and habitat—Throughout the province in the hills particularly abundant in sal and mixed forest on laterite hills and other ferruginous rocks in Bonai, Pal-Lahara, Keonjhar and Kalahandi.

Silvicultural characteristics—Nothing much is known about these except that the tree is decidedly frost-hardy.

Uses—The wood is exceedingly tough and might possibly prove suitable for shuthles. It is a good fuel and yeilds good charcoal The bark yeilds a fibre and a gum used in making sweetmeats.

Silvicultural characteristics—The tree can be raised with ease by line sowings if well weeded. The seedlings are somewhat sensitive to transplanting but this can be overcome with care. They should be transplanted while still small during the first rains.

Uses—The wood is pinkish-white, turning dark-brown on exposure; It is moderately hard and is used for agricultural implements, when large enough, and also for fuel. The bark gives a fibre and the leaves are cooked and eaten as vegetables, for which purpose the branches are kept pruned. The bark is sometimes used for tanning.

Bauhinia r swe Bauhinia Vahlii—Siahli, sialpat (Oriya) ; Maljant, mahul (Hindi); Jomlar, lamak'lar (Santali) ; *Pai ka tula*, paimala, gair tula (Kondh).

An immense climber, common throughout the province but more especially on hills and in rocky ravines. The stem attains 3-4 feet in girth. The seeds are edible ; the bark yields a fibre which is much used as cordage ; and the leaves are used as plates.

Another fairly common *Bauhinia* is B. *racemosa* (Ambalota, *Oriya* ; Amata in Baramba Koap riding, Rotul (Kondh).

65. TAMARINDUS INDICA

Local names—Tentul, Tentuli (Oriya, Bengali) ; Koinya (Oriya) ; Amli, imli (Hindi) ; Jojo (Ho) ; Jojor (Santali); lili neting, teten (Kond).

General description—A very large and handsome evergreen tree, attaining 100 feet in height and 15 feet or more in girth. The crown is round and spreading with pinnate leaves carrying 10 to 20 pairs of leaflets, each about ½″ long. Bark, dark-grey and deeply cracked, about ½″ thick. The small red and yellow flowers are borne in racemes from April to June. The pods, which are curved and about 3″—6″ long, contain 3 to 10 reddish brown seeds and ripen from December to February.

Distribution and habitat—Commonly grown in villages throughout the province and often found in the forest on old village sites. It is said to be a native of Africa. A common roadside and avenue tree.

Silvicultural characteristics—The tree is not exacting as to soil. It is tender to frost but stands drought well. It produces root-suckers. Nothing will grow under its shade as a rule; this is not entirely due to the shade but also to other factors. Its growth is rather slow.

Reproduction—The tree can easily be propagated from seed sown direct in April or by transplanting during the first rains. It develops a long tap-root and hence is difficult to transplant in the second year, although second-year root-and shoot cuttings can be used.

Uses—The sapwood is large and yellowish in colour ; the heartwood is small, dark purplish-brown, very hard, heavy and durable. The wood is extremely difficult to work but is used for rice-pounders, sugar and oil-mills.

The fruit is used as medicine and also made into preserves. The leaves are said to be used in curries. Tents pitched under it are damaged by the acid in the leaves. It is said to be unhealthy to sleep under a tamarind tree.

66. SARACA INDICA

Local names—Oshok (Oriya, Bengali) ; Asoka (Hindi) ; Usang'd-ba (Ho).

General description—Though not of forest importance this tree deserves mention as being probably quite the most beautiful flowering tree in our forests. It is rare and is only found in deep, damp, cool ravines growing close to running streams. It is a small evergreen tree with pinnate leaves, carrying 3—6 pairs of dark green oblong-lanceolate leaves. The flowers are bright orange-scarlet and appear in dense corymbs 3″—4″ across in March and April. The seeds ripen in September and germinate in December. It occurs in Bo'ah block, Keonjhar, Kuldia block, Niligiri ; Similipal hills, Mayurbhanj ; Saptosajya block, Dhenkanal ;Rajin block, Puri; and also probably in Bonai. The leaflets of the young leaves are red in colour and limp. It is a sacred tree and the flowers are used in temples. It can be raised with ease from seed provided it is sown in a rich soil and kept moist. Shade is beneficial.

MIMOSACEÆ

67. XYLIA XYLOCARPA

Local names—Kongra (Oriya) ; Tangan dangadi, tingan (Khond Kalahandi) ; Dengan (Patna) ; Suria (Hindi) ; Katsiahli (Bamra) ; The Indian Iron wood.

General description—A moderate-sized, rarely a large, deciduous tree with smooth reddish-grey bark, exfoliating in large irregular patches. Leaves compound, bipinnate, with one pair of pinnae, each pinnae usually with 5—6 pairs of leaflets, 2″—8″ long. The leaves are shed in February and the yellowish-white, fragrant, globose flowers appear with the new leaves in April—May. The pods are flat and woody, about 6″ long and dehisce (split) on the trees when ripe in February—April following the flowering. The seeds are flat, oval, ½″—¾″ long by ½″ broad, brown, smooth, shining moderately hard.

Distribution and habitat—This tree occurs scattered locally throughout Orissa. It is common in the north of Khurda in Puri district on sandstone, where it is of small size, seldom exceeding 40 ft. in height and 2½ ft. in girth. It is met with again in Athgarh, Dhenkanala, Baramba and Narsinghpur attaining a girth of 6 ft. in the hills of the last two. It is met with very occasionally in the south-east of Angul near Rasanda, Raigoda block. It occurs sporadically in Pal-Lahara ; in Pabuii block, Bamra ; in Mayurbhanj ; and has been seen in Karampada block, Singbhum South of the Mahanadi it again appears in the extreme west of Baudh ; in Patna South of the Tel river ; and in the south Kalahandi hills (seen near Moulpatna).

It appears to be found invariably in association with sal in our area. The growth is poor on dry, shallow soils, as in Puri, but where the soil is deep, well-drained and moderately moist it attains a large-size.

Silvicultural characteristics—The tree is a shade-bearer, especially when young, but it cannot compete with heavy shade-bearers in evergreen forest. It tends to be gregarious on shallow soil over laterite and sandstone in Puri, although it grows best on deep soils. It withstands fire well. It coppices freely and produces root-suckers in abundance. The tree is capable of rapid growth under favourable conditions. It is immune to damage from grazing.

Reproduction— Natural reproduction is frequently good, so it should not be a difficult species to regenerate. Recent experiments in Dhenkanal are as yet in conclusive.

Uses—The wood is brown in colour, extremely hard, heavy, strong, and very durable. It is difficult to work. It is used for building and agricultural implements in Puri and Kalahandi, but is generally speaking not much valued ; probably owing to its comparative scarcity and small size. Moreover, *sal*, being usually available, is preferred. It is used for sleepers in Sough India. It is a tree well worth encouraging where it occurs naturally.

68. ACACIA ARABICA

Local names—Babul, kikar (Hindi) ; *babul, babur*, in our area.

General description— A small or moderate-sized almost evergreen tree attaining 4½ft. in girth but often flowering as a shrub, with a rounded crown, feathery foliage and long, straight, white spines, something 2″ long. The bark is dark brown, almost black, with deep fissures often running spirally up the tree. Blaze, deep brown, then pink. The leaves are compound with 3—6 pairs, of pinnae, each with 10—20 pairs of small leaflets. The yellow globose flowers are about ¼″ in diameter, scented and appear from August to December. The fruit is a pod, 3″—9″ long, containing 8—12 dark brown seeds, constricted between the seeds. They ripen in January– April, but the pods do not open.

Distribution and habitat– Not found in the forest but occurs in open country on alluvial or black-cotton soil. It is not very common in Orissa, but it is frequent in parts of Khandapara, Banki and parts of Puri district ; and in Patna on blackcotton soil in the Bairasar pargana. Elsewhere it is commonly planted on railway embankments and on *bandhs*. It is one of the few species that thrives on black-cotton soil. A certain amount of moisture in the soil and sub-soil is essential. It is a useful species for afforesting ravine lands.

Silvicultural characteristics– The tree is a strong light-demander and will not tolerate shade. It has a long taproot and develops strong lateral roots, which make it a useful tree for fixing soil on embankments, etc. On the whole, it coppices poorly. Small stumps generally produce shoots but these rarely develop beyond the shrub stage. It pollards well. *Babul* is frost-tender but is drought-resistant so long as there is sub-soil water. It is easily killed by fire. Young plants are very susceptible to damage by animals, especially camels, goats, buffaloes, deer, hares and rats. It is also subject to the attack of certain insects and fungi. Another source of injury is lopping for fodder and fencing.

Reproduction– Natural reproduction is often good provided soil and light conditions are adequate and there is an absence of weeds. Seeds often do not germinate the first year, but this is greatly accelerated by animals, especially goats, which eat the pods and void the seeds, which then germinate rapidly.

Owing to its long tap-root, *babul* does not transplant easily, but direct sowings are very successful provided the soil is suitable. The seed should be passed through goats to make it germinate rapidly, or it may be soaked in water and heaped up with cow dung. Weeding is essential and grazing must be excluded. The soil should be thoroughly loosened.

The rate of growth varies considerably but on the whole is rapid.

Uses—The sapwood is whitish and large; the heartwood is pinkish turning reddish-brown on exposure. It is hard, heavy and very durable, if well seasoned. It is excellent for agricultural implements, wheel-work, house-building, etc. The bark is extensively used for tanning . The pods are rich in tannin and are largely used as fodder for cattle and goats. The twigs and leaves are also used as foddder and the thorns for fencing. The bark yields a gum which is used in dyeing and medicine. Lac is cultivated on the tree in Sind. The wood is a good fuel. The bark is rich in tannin and is valued as a tanning reagent.

69. ACACIA LEUCOPHLOEA.

Local names—Gohira, goira (Oriya); Gulura, reimja (Sambalpur).

General description—Usually a small or moderate-sized deciduous tree, but sometimes it attains 6 feet in girth, with a spreading crown. It is generally thorny but is occasionally found without thorns. The bark is greenish-white and smooth but is dark and rough in old trees, exfoliating in irregular flakes. Blaze, light-red, sometimes streaked. The flowers are yellowish-white and appear in small globose heads, ¼″ in diameter, from August to October. The pods are 4″—8″long flat, slightly curved and ripen from January to April. They contain 10—20 dark brown shining seeds.

Distribution and habitat—The tree is fairly common through out, Orissa mostly on waste land and in scrub jungle. It is commonly met with on black-cotten soil. It is not found in dense forest, where it cannot become established on account of insufficient light.

Silvicultural characteristics—A strong light-demander. It stands drought well and is frost-hardy, although the seedlings are sensitive in this respect. It coppices well and produces root-suckers. It suffers from browsing, especially from goats. The tree is said to be of slow growth.

Reproduction—Direct sowing gives better results than transplanting. Regular weeding is essential.

Uses—The heartwood is comparatively small, reddish brown streaked with darker and lighter colour. It is heavy, strong, hard and tough, seasons well and takes a good polish. It is not in much demand but is used for ploughs to some extent. It is actually suitable for many purposes, such as agricultural implements and is an excellent fuel. The bark yields a fibre.

70. ACACIA CATECHU

(and its variety Acacia catechuoides)

Local names—Khair (Oriya, Hindi, etc.);Khoiru (Oriya), keher (Kandh).

General description—A small deciduous tree with a light feathery crown and hooked thorns. The bark is blackish, rough, exfoliating in long narrow strips. The blaze is hard, brown, then deep pink. The small white globose flowers appear with the new leaves in small spikes, 2″—2½″ long from July to August. The straight, flat, dark-brown pods, 2″– 4″ long, conrain 3—6 dark greenish-brown, smooth, shining seeds and ripen from November to January. The pods split after ripening and commence falling in January. The tree very rarely exceeds 4 ft. in girth in this province.

Distribution and habitat—Throughout the province in dry open forest, sometimes gregarious. It is very abundant in Patna moderately so in parts of Kalahandi, Angul and Rairakhol. Elsewhere not very common . It survives on poor dry soils, is commonly found on black-cotton, but prefers a well-drained alluvial soil. It is met with on eroded ravine-land with *kankar*,where few species will survive, and on almost bare shale in the west at Sambalpur.

Silvicultural characteristics– It is a very hardy tree: a decided light-demander: very frost-resistant: and on the whole stands drought very well. It coppices vigorously and produces root-suckers. The growth of coppice is rapid. Seedlings also show rapid growth provided they are not suppressed by weeds and grass or damaged by grazing, to both of which evils it is very liable.

Reproduction—Natural reproduction is often very slow on account of suppression by grass and excessive grazing. Seedlings are also killed off by rats. The young plant rapidly develops a long tap-root. Drought also kills off a number of seedlings but the chief danger is from grazing.

The tree can be raised most easily by direct sowings (preferably with field crops) and this method gives excellent results. Transplanting is not recommended. Repeated weeding and protection against cattle and deer is essential to success.

Uses—The heartwood is light or dark-red in colour, very hard, heavy and durable. It seasons well, takes a good polish and is a handsome wood. It is used for oil and sugar-presses, agricultural implements, wheel-work and a variety of purposes. It is a first class fuel and yields a high grade of charcoal.

The chief product of the tree is *kath* (catechu),which is manufactured by boiling down the heartwood after it has been redcued to small chips. *Kath* is a light-brown astringent substance, which is used for chewing with betel (*pan*). *Kath* of excellent quality is manufactured in Palamau district, but that prepared in Orissa is dark in colour and of inferior quality.

"Cutch" a black shining substance, is also extracted from the wood and is used for dyeing, for preserving fishing nets and for tanning.

Acacia lenticularis—(Kanta-siris, garkhair)—a moderate sized or large evergreen tree, rather like *Albizzia* in appearance. It occurs through out Orissa and sometimes reaches a girth of 6 ft. It is met with rather more frequently in dry forests in the west of Orissa.The wood is very heavy, hard and strong. It is occasionally used for making ploughs, but is not sufficiently common to be much demand.

71. ALBIZZIA PROCERA

Local names—Tentra, maranga (Oriya); safed siris (Hindi); Pandrai (Ho).

General description—A large, tall, straight tree with greenish-white bark and light foliage. It is deciduous for a short period in May—June. Leaves, compound with 3—6 pairs of pinnae, each having 5—11 pairs of leaflets 1″-2″ long by 1-1½″ The large panicles of greenish-white flowers appear in August—September. The thin, strap-shaped pod is 4″—8″ long and ripens from January to May. The pod contains 6—12 flat, smooth brown seeds, and splits open when ripe. The bark is rather thick with a red blaze. The tree attains a height of over 100 ft. and a girth of 7-8ft.

Distribution and habitat—Found in all districts, usually in damp valleys on deep fertile soil and seldom far from a stream. It is nowhere a common tree.

Silvicultural characteristics—Although standing moderate shade in youth, the tree is a light-demander. It is fairly drought-resistant in its natural habitat, but does not succeed under really dry conditions. It is very frost-tender. Its rate of growth is extremely rapid, reaching a girth of 4—6ft. in 30 years.

Reproduction—Direct sowing gives better results than transplanting owing to the long tap-root which is developed at an early age. The soil should be loosened and kept moist; and regular weeding should be carried out . The tree grows readily from cuttings.

Uses—The sapwood is large but in mature trees the heartwood is considerable. It is moderately heavy, even-grained, hard and brown in colour. It is not much used locally owing to its scarcity but is a good timber for oil-mills, wheel-work, sugarcane crushers and furniture. It seasons very readily in the plank and is particularly suitable for furniture owing to its handsome appearance and good lustre. It does not tend to crack or warp but shrinks somewhat if not well-seasonsed.

The leaves and small branches make good fodder for elephants and camels. The bark yields a gum but this is not known to be of any use. The wood is a first class fuel.

72. ALBIZZIA LEBBEK

Local names—Siris (Oriya, Hindi, Bengali); tentra (Oriya); The East India walnut, or Kokko".

General description—A medium-sized or large deciduous tree attaining 8ft. or more in girth with a spreading umbrellashaped crown and a short bole when grown in the open. Bark, dark-grey, rough, with irregular cracks; blaze, deep crimson or red. Leaves, compound with 2—4 pairs of pinnae, each having 6—8 pairs of leaflets (rarely up to 13). The leaves are shed rather irregularly but normally in the hot season. The flowers are yellowish-white feathery and fragrant. They are conspicuous against the new green foliage in May—June. The flat pods are straw-coloured, 6"—12" long by 1"—2" broad. They ripen in January, split shedding their seeds and remain on the tree until March or April. The pods contain 6—12 seeds.

Distribution and habitat—One of the commonest roadside trees throughout the province and frequently planted in gardens. It is said to occur naturally in the forest but it is certainly very rare. *Alibizzia odoratissima* is liable to be confused with it. It is reported to grow wild in along streams near Nakchi in Athmalik; Tikerapara and Baghmunda. Angul: and in the Mals of Puri.

Silvicultural characteristics—For its best development it requires full overhead light, but seedlings will stand moderate shade. It is not exacting as to soil and will grow fairly well even on laterite and black-cotton soil. The root system is shallow, hence it is liable to be thrown by wind. Seedlings are frost-tender. The tree is browsed by camels. It does not coppice very well. It grows easily from cuttings. Growth is rapid.

Reproduction—The tree can be grown direct from seed or by transplanting from the nursery, but the former method gives the better results.

Uses—The sapwood is large ; the heartwood is dark-brown with lighter and darker streaks. It is moderately heavy, hard, seasons easily, works and polishes well and is fairly durable. It can be used for many purposes but is specially suitable for furniture owing to its very handsome appearance and good lustre when polished. It is exported to Europe from Burma and the Andamans under the name of "Kokko".

73. ALBIZZIA ODORATISSIMA

Local names—Tentra, tentula, tinia (Oriya) ; kali siris (Hindi); kiachalom (Ho); jang siris (Santali); kin, slendu (kondh).

General description—Rather similar to '*A. lebbek* in general appearance but the pods are narrower and dark-brown or red in colour (not straw coloured). It is evergreen. It occurs throughout the forests of the province, chiefly in valleys but is not very common. It is very similar in its characteristics and requirements to '*A. lebbek*, except that it bears somewhat more shade. It coppices fairly well.

The wood is indistinguishable from that of '*A. lebbek*, but is perhaps a trifle darker. It is handsome and suitable for furniture. The twigs and leaves are lopped for cattle fodder.

74. ALBIZZIA CHINENSIS

(*Syn. Albizzia stipulata*)

Local names—Ghora-lenja (Oriya); barabga (Kalahandi); kala siris (Hindi); japud (Ho); chapot, kera-serom (Santali).

General description—A large, handsome, almost evergreen tree with feathery foliage. Bark, dark-grey, smooth with transverse furrows. Blaze, crimson. Leaves about 12" long, compound, with 12—20 pairs of pinnae each bearing 30—40 pairs of small leaflets. It attains a height of 100 ft. and a girth of 8 ft. or more. The tree is leafless for a short period in February. Masses of sweet-scented yellowish-white flowers appear in May—June amidst the new foliage. The pods are 3$\frac{1}{2}$—6″ long by $\frac{3}{4}$″ , flat, containing 8—12 seeds and ripen from October to April. They split open after falling from the tree.

Distribution and habitat– The tree is found in moist valleys near streams in forest throughout the province, especially in the Damper districts. It is nowhere very common but is perhaps somewhat more frequently met with south of the Mahanadi river.

Silvicultural characteristics– A moderate light-demander. It is rather sensitive to drought and frost. The growth is extremely rapid.

Reproduction– The tree can easily be raised by direct sowing, which gives better results than transplanting.

Uses–The sapwood is large ; the heartwood is light brown in colour, softlight, shining and not durable. It can be used for boxes and packing cases ; dugout canoes are made from it in parts of Orissa, its large diameter rendering it suitable for this purpose. It is probably fairly durable in water. The branches are lopped for cattle-fodder. It is used as a shade tree in the tea gardens in Ranchi. The wood seems suitable for light cheap furniture, as it is easy to work and has a good appearance.

COMBRETACEAE

75. TERMINALIA BELERICA

Local names– Bahada (Oriya) ; bahera, bebra (Hindi) ; lupuny (Ho) ; dasang, tandi (Kondh).

General description—A large deciduous tree attaining a height of 120 ft. and a girth of 10 ft. or more, usually with a straight bole and a large rounded crown. Large trees frequently have buttresses at the base. Bark, ashy-grey with many small longitudinal cracks ; blaze, yellow, Leaves 3"—8" long, broadly elliptic or obovate, culstered at the ends of the branches. Leaves fall in January and are renewed in March—April. The flowers are small, greenish-white, appearing in spikes from March to May with the new leaves and smelling very strongly of honey. The fruit is ovoid or globose, fleshy, about ¾" in diameter, with a grey velvety covering. It ripens in January—February.

Distribution and habitat—Throughout the province, chiefly in mixed forest in the north ; associated with sal usually in moist localities. It is not a common forest tree but is frequently seen in village lands where it is preserved.

Silvicultural characteristics—The tree is a light-demander but can stand light shade in youth. It is very sensitive to frost but hardy to drought, although it does not occur naturally in very dry positions. It coppices well and grows rapidly.

Reproduction—Natural reproduction is assisted by animals eating the fleshy part of the fruits and voiding the stones. Moisture is necessary for germination and seeds usually fail if exposed to the sun, the radicle drying up or being eaten by insects and birds.

The tree can be raised artificially by transplanting, if this is done in the first rains before the taproot becomes too long. The rate of growth under favourable conditions is fairly rapid.

Uses—There is no heartwood ; the wood being yellowish-grey, hard in large trees but not durable, although it lasts fairly well under water. It is little used but can be utilized for rough planking and packing cases. The fruits can be used for tanning but are inferior in quality. They are used for mixing with the Chebulic myrabolam, the fruit of *T. chebula.* The kernels of the fruits are eaten. The tree yields a gum which is said to be eaten by the Santals. The fruit is also used in medicine and ink is made from it.

Where no other timber is available, that of *behera* can be used for various purposes if soaked in water.

76. TERMINALIA CHEBULA

Local names—Harida (Oriya) ; harra (Hindi, Bengali); rola (Ho); kasa-phal (Mayurbhanj); Haritaki (Bengali); irapi, irpi, tarahu, bravungi (Kondh); the Chebulic Myrabolam.

General description—A small or moderate-sized deciduous tree with a rounded crown and a short bole. Bark, about ¼″ thick, dark-brown, often with longitudinal tracks, exfoliating in flackes on old trees. Blaze, hard, deep grey-brown, then yellow. sometimes with a reddish zone. Deciduous in February—March. The leaves are oval or elliptic, 4"—7" long by 2"—4" broad. The new leaves are often copper-coloured. Flowers, whitish in small panicles with the new leaves in April—May. The fruit is an ovoid or ellipsoid drup, 1′—1½″ long, light-brown in colour and five-ribbed when dry. It falls after ripening from November to February. Young leaves and shoots are often silky and silvery in colour.

Distribution and habitat—Fairly common throughout the whole province, especially in dry deciduous mixed forests. It is found under a great variety of conditions and is very tolerant of poor dry soils. It is a common associate of sal but is perhaps more typical of open village forests. It is distinctly more abundant in the west of Orissa, in Sambalpur and towards Chhattisgarh. Haines says that it appears to favour clay soils. It will grow on black-cotton soil, but also occurs on laterite and sandly soils.

Siivicululal characteristics—The tree is a light-demander but stands shade in youth. It resists drought, frost and fire well. It coppices freely and grows rather fast.

Reproduction—Germination is poor and the seed is liable to attacks by insects, squirrels and rats. It is difficult to propagate artificially, the best method being to dry the fruits, removing the fleshy covering and sowing in boxes during the rains. They should be watered regularly and transplanted in the first or second rainy season. Even this method does not give a very high percentage of germination.

Uses—The wood is brownish-grey, with a greenish tinge very hard, heavy and durable. It takes a good polish and is suitable for various purposes but is little used since the chief importance of the tree lies in its fruit—the chebulic myrabolam of commerce, which is extensively used for tanning. The best "nuts" are light yellow in colour and are collected off the ground as soon as they fall. They are dried and exported whole, or the fleshy portion is frequently removed for export in order to save freight. It is sent to Europe in large quantities. The fruit is also used for dyeing and ink, and is used in Hindu medicine.

77. TERMINALIA ARJUNA

Local names—Arjun (Oriya, Hindi); kahua (Hindi); Gara hatana (Ho); pani mardi (Kondh).

General description—A large, handsome, almost evergreen tree, with drooping branches and pale greenish or grey bark. Bark, about 1½″ thick, smooth ; blaze, deep red, distinctly zoned The small white flowers appear in May– July. The fruits have five to seven wings and resemble those of *T. tomentosa.* They are 1″– 1½″ long and ripen in March– April. The leaves are oblong and something like those of *T. tomentosa*, but narrower. The tree reaches a very large size attaining frequently a height of 100 feet and a girth of 12 feet or more ; trees of over 20 feet girth are occasionally found. There is a remarkably fine straight grown tree in Hathidhara block, Athmallik, which must be almost 150 ft. in height.

Distribution and habitat—Throughout Orissa along streams rare in Puri, Balasore and Cuttack but more frequent in the west of the province, in Gangpur, Sambalpur, Khariar, Patna and Kalahandi. The tree is never found naturally away from the banks of streams or rivers, but it is sometimes planted as a roadside tree. To reach its maximum development a sandy soil with a plentiful water-supply is necessary.

Silvicultural characteristics—The tree is a moderate shade-bearer. It is sensitive to drought and seedlings suffer from frost. It coppices well up to a girth of 2½ ft., pollards well and produces root-suckers. The rate of growth is fairly rapid. The tree is difficult to kill by girdling.

Reproduction—The seeds do not germinate readily if exposed. They require moisture and a certain degree of shade assists the establishment of the seedlings. The plants bear transplanting well and this should be done in the first rains before the tap-root develops.

Uses—The heartwood is brown, very hard, heavy, strong and durable . It is hard to work, difficult to season and tends to split badly. It is quite a handsome wood but is not much used in our area. Elsewhere it is used for carts, building and agricultural implements. The bark is used for tanning, the outer bark being best. It is also used in medicine.

78. TERMINALIA TOMENTOSA

Local names—Sahaj, sahaja (Oriya) ; Asan, saj, sain (Hindi) ; Hatana, atana (Ho, Santali) marada, mardi (Kondh).

General description—A large deciduous tree with a straight stem and a large crown. The bark is dark-grey or black, 1—1½″ thick very rough with longitudinal and transverse cracks dividing it into numerous oblong scales. Blaze red. The leaves are rather coarse, oblong or ovate, 5"—9" long and occasionally larger in young plants, with very distinct nerves. The under surface of the leaf is distinctly pubescent (covered in short hairs). The leaves fall in March and are renewed in May. The masses of white blossom appear early in June in spikes of small whitish flowers. The fruit is 1½″—2" long (sometimes 3") with five wings and is brown when ripe. It develops rapidly, being full-sized about October. The fruits remain pale yellowish-green from November to January and ripen about February-March, falling from the trees from March to May. The tree varies a good deal in details of appearance and in minor characteristics. The fruits are often prematurely damaged by parrots, and galls are formed by an insect which have the appearance of fruits but do not resemble the winged fruits. The tree attains a height of 100—120 ft. and frequently exceeds 7 ft. in girth. Large trees are buttressed at the base. In many of our dry forests it remains a medium-sized tree, not exceeding 4 ft. in girth.

Distribution and habitat—The *asan* is one of the commonest most widely distributed trees in the province, equalling sal in this respect although it is not so gregarious and does not form such pure crops. It attains its largest dimensions on deep, moist soil in valleys but is also found growing on poor shallow soil on hilly ground, on laterite, on black-cotton soil, on stiff clay and even in eroded calcareous (*kankar*) ravine lands. Its growth is stunted on black-cotton and calcareous soils but it does well on damp and even water-logged soil on clay, where few other species will grow.

It is one of the commonest associates of sal and is also one of the principal species in mixed deciduous forest with *Anogeissus latifolia* and bamboos. The latter type of forest is particularly common in parts of Angul, notably in Katrang block. It is not frequently found coming up on abandoned cultivated land, even in deserted paddy fields. In certain areas it is commonly associated with *karla* (*Cleistanthus collinus*) and a few other species on clayey soil. It occasionally is met with in gregarious patches in good alluvial soil near streams. A very hardy tree.

Silvicultural characteristics—Asan is a light-demander but seedlings stand slight shade. They are, however, intolerant of direct overhead shade. It is not exacting as regards soil but grows best on deep, rich, moist, well-drained loam. It stands moderate drought but is killed by severe drought, although seedlings are fairly hardy in this respect. The leaves are killed by frost but the tree does not appear to suffer otherwise ; seedlings, are, however easily killed by frost. Seedlings and young plants are much browsed by deer and cattle, but they are not killed and rapidly develop if protected. They suffer less than sal in this respect since they are leafless in the hot weather . The very young leaves are subject to attacks by birds.

The tree coppices readily up to 4 ft. girth and produces a large number of shoots. It produces vigorous pollard shoots, trees being commonly pollarded in Mayurbhanj ; N. Keonjhar and Bonai for *tassar* silk rearing. The tree also produces root-suckers and has a deep root system.

The rate of growth of coppice is fast, being more rapid than sal. The rate of growth of seedling trees under natural conditions is approximately the same as that of sal.

Reproduction—Although the power of germination is poor, the amount of regeneration found in the forest is fairly good, indicating that a sufficiently large number of seeds to germinate and that the seedlings are hardy and survive in spite of the damage by deer. It is more successful on bare ground than where weeds are plentiful. A greater percentage of success is obtained if the seeds are slightly buried. Moisture assists germination which may take place under shade, but the seedling will not survive unless the shade is removed, although they can make their way through a moderate growth of grass. The most favourable conditions therefore are : (1) abundance of light, (2) a fair degree of moisture, (3) bare ground, (4) loose soil, (5) absence of dense weed-growth, frost, fire and grazing.

The tree can be raised artificially by direct sowings or by transplanting before the tap-root is too long. Both methods give good results. The seeds should be sown not long after they ripen. Regular watering is most beneficial. Weeding is important.

Uses—The heartwood varies a little in colour but is usually dark brown with darker streaks, extremely hard and difficult to work, very heavy, strong and fairly durable. It lasts well under water. It is difficult to season ; this being best done in the log under water. It is a very handsome wood and takes a fine polish. It is extensively used for a variety of purposes and replaces sal where the latter is difficult to obtain. It is suitable for all kinds of heavy work, agricultural implements and house posts, but its weight, hardness and liability to split are against it when compared with sal. It is much used as floor-boards in railway wagons. It has been used in the past for sleepers but cracks badly when exposed to the trying conditions imposed upon it in the open. It is a very handsome, if very heavy, furniture wood and is used in Europe for panelling and furniture under the name of "Laurelwood". The climate of Europe not being so extreme, it does not tend to split to the same extent as in India.

The wood is an excellent fuel and makes a good charcoal. The tree is pollarded in Chota Nagpur and parts of north Orissa, the *tassar* silk worms being fed on the young leaves. Wild *tassar* cocoons are commonly found on this tree. Large numbers of *asan* are retained on cultivated and waste land for the purpose in Singhbhum, Mayurbhanj and Keonjhar.

The branches are often lopped for buffalo fodder and the bark is occasionally used for tanning but is inferior.

79. ANOGEISSUS LATIFOLIA

Local names– Dhau (Oriya) ; Dhaura (Hindi); Hesel (Ho, Santali) ; Muniah (Khond) midiyang (Kondh).

General description – A moderate-sized or large deciduous tree with a long straight bole and a light rounded crown, frequently with drooping branchlets. It attains a height of 80– 100 ft. and 6– 7 ft. in girth in favourable positions but is generally much smaller. Bark, thin, smooth, pale greyish-white, exfoliating in thin rounded scales ; the outer layer contains cholorophyll. Blaze thin with a green (chlorophyll) layer, then brownish pink and brown next the wood . Leaves simple, oval, 2"– 4" long. rounded at both ends, turning red or brown in December and falling in February. New leaves in April– May. Flowers small, greenish-yellow, in small globose heads from June to September. Fruits small, dry, yellowish-brown, with a narrow wing on each side in small globose heads. They ripen from December to February.

Distribution and habitat—Very common throughout the province especially on hot, dry, rocky hills, where it does not reach a large size. It is not common near the coast in Orissa. This species forms a high proportion of the crop on dry hills, as in Sambalpur, Patna and elsewhere, where it is generally a small tree rarely exceeding 3 ft. in girth. In Angul it reaches a large size. It is most common in dry mixed deciduous forests and very often occurs in association with *asan* and bamboos. It is also a common associate of sal more especially in dry situations but is found on the fertile lower slopes of hills where it attains a large size. On hot stony aspects it is found together with *Cochlospermum gossypium*, *Sterculia urens* and *Boswellia serrata.* Although it is a hardy tree that will grow on poor soils, it requires good drainage and will not thrive on swampy or badly-drained ground.

Silvicultural characteristics—The tree is a decided light-demander although seedlings will bear slight shade. Seedling suffer somewhat from frost but the damage is not serious. In spite of the fact that it grows in very dry situations, it is damaged by severe or prolonged drought. It suffers less than most species from grazing and browsing. It is damaged by fire, and trees often become crooked and defective from this cause.

It develops a strong tap-root at an early age. It pollards well and produces root-suckers. Its coppicing power varies considerably being good in some localities and poor in others. Experiments have shown that the season of felling is a most important factor. The best results are likely to be obtained from stumps cut in May. Those cut in April also give good results but trees coppiced in June and July are poor, and those cut in August and September are not likely to give any shoots. The rate of growth of coppice shoots is moderately fast ; that of seedlings rather slow.

Reproduction—The tree seeds abundantly every year but the fertility of the seed is extremely low. The growth of the seedling in the first year is only moderate, but the tap-root grows vigorously. Natural reproduction is very variable. It is always best on bare soil with good drainage and abundant light. Absence of weed-growth favours regeneration, which is often good on burnt areas.

The seeds should be collected when the heads start to break up and not before. If sown in beds in June and lightly watered, good results are obtained provided the beds are kept moist by a covering of branches and leaves. The seedlings can be transplanted with case. This is a difficult tree to raise artificially owing to the poor fertility of the seed, which is often as low as 2 or 3 per 1,000.

Uses—The wood is grey or yellowish-grey, hard, heavy, tough, strong and elastic with a very small irregular dark-brown heartwood. It is said not to be very durable but is extensively used for cart-axles, axe-handles, shafts, etc., where toughness and elasticity are required. It is also used for agricultural implements, poles and rafters and is much prized in Bihar. It would be used even more extensively but for its tendency to split. It is a very good fuel and gives a good grade of charcoal.

The twig-bark and leaves are used in tanning, but not extensively.

This is one of the most generally useful economic timbers of of the province owing to its abundance and qualities. Being much cheaper than sal, it is much used by the poorer classes for a great variety of purposes, and in many places where sal is difficult to obtain it supplies a substitute.

80. ANOGEISSUS ACUMINATA

Local names—Phasi (Oriya) ; Chakwas (Bengali) ; Gara-hese (Ho) ; Sahara, pampunia (Kalahandi).

General description—A large deciduous tree with a straight bole, spreading crown and graceful drooping branches. It reaches 8—10 ft. in girth and a height of 90—100 ft. Bark, drak grey, almost black, rough and cracked ; blaze, red. The leaves are small, $\frac{3}{4}''$—2" long, elliptic, acuminate (pointed at one end), shining above. It is almost evergreen, shedding its leaves for a short time only in March—April, flowers March—April ; fruit April—May.

Distribution and habitat—From Singhbhum southwards through Orissa. It is only found on the banks of streams and large rivers. Common along the Mahanadi, especially in Daspalla ; also in parts of Puri and Kalahandi and along the lower reaches of the Baitarani in Keonjhar. It is by no means a common tree but is sometimes gregarious on sandy soil along river banks, as in Daspalla. It grows in much the same localities as *arjun* (*T. arjun*) and *jamun* (*Eugenia jambolana*) but is much scarcer than either of them.

Silvicultural characteristics—Little is known about the characters of this tree since it is silviculturally unimportant. The seed is very infertile and it would therefore be difficult to regenerate artificially.

Experiments carried out in Daspalla (1944—48) and still in progress indicate that a germination percentage of 60 may be expected in that locality one week after sowing in carefully prepared beds. At the end of one year plants were 18—24 inches high and up to 36 inches at the end of the second year. Direct sowing in the plantation area did not give good results; and transplanting proved a complete failure. Stump-planting gave promising results amounting to 60—80 per cent of stumps put out.

Uses—The timber is very similar to that of *dhaura.* It is said not to be so durable ; it warps and cracks in seasoning. Being a rare tree it is little used but could be used for the same purposes as *dhaura.* It is an excellent timber for tool handles but needs careful seasoning.

MYRTACEAE

81. SYZYGIUM JAMBOLANUM

(*Syn. Eugenia jambolana*)

Local names– Jambu jamkuli (Oriya) ; Jamun, jam (Hindi) ; Kuda (Ho); so-kod (Santali) ; kala-jamb (Bengali) ; noandra (kondh).

General description– A large, handsome, evergreen tree with a rounded crown and dark, shining, green foliage. Leaves, oblong, mostly 4″ long or more and pointed. The bole is usually crooked but is sometimes long and straight some fine specimens being found near Rasanda in Angul. It attains a height of 100 ft. and a girth of 8 ft. and more. The bark is about 1" thick, light or dark-grey and often pitted or cracked when old ; blaze, deep red or brown. The panicles of small, greenish-white, sweet-scented flowers appear in May-June. The fruit is a dark purple or black, ovoid, juicy berry, ½″—1″ long, it ripens in July.

Distribution and habitat—Very abundant throughout the province, both wild and planted. It is one of the common roadside trees. The tree is found in valley bottoms in moist localities and attains its maximum development in sheltered, cool, damp ravinces, where it is often gregarious. It is a common associate of *sal* and is fairly tolerant as regards situation, for it is often found in quite dry position but does not reach a large size there. The small stunted *Eugenias* found growing on dry rocky hills are usually different species or varieties, which resemble *E. jambolana* in many respects and, need not be described here.

Silvicultural characteristics—*Jamun* is a shade-bearer, especially when young. It is rather frost-tender in youth but hardy later on. It is not much affected by drought except along streams if the latter dry up for a prolonged period. It is not readily grazed and is difficult to kill by girdling. The tree coppices extremely well and sends up numerous shoots which grow very rapidly.

Reproduction—Natural reproduction is profuse on damp soil, each fruit producing 1—4 seeldlings. Dense masses of reproduction are sometimes met with in moist localities. Without moisture and shade the seedlings perish rapidly.

Direct sowings give better results than transplanting under artificial conditions. The soil should be well loosened, the seedlings regularly watered and adequate shade (preferably side shade) provided. Weeding is important . Germination is usually very good. Growth during the first year is slow, but subsequently is rapid . Natural seedlings can be successfully transplanted from the forest under shade.

Uses—The timber is reddish-brown or reddish-grey, moderately hard, rough and fairly durable. It rather resembles *sal* in appearance. It is used for building, agricultural implements, well-curbs, etc., and has been used for sleepers. It stands water well. It is a very good fuel and makes good charcoal. The bark can be used for tanning but is inferior. The fruit is eaten but is very astringent and is used in medicine. The tree is an excellent avenue tree, except in very dry situations. An excellent jelly can be prepared from the fruit.

Syzygium operculatum (Syn): *Eugrnia operculata* ; Pui-jam, *Oreya*; nakud jambu, (*Kondh*). A small, spreading tree with large obovate, rounded leaves 5"—7" long, turning red before falling and having a pleasant distinctive lemon-like odour when crushed.

Widely distributed, most commonly found in moist ground (grassy glades) and near streams.

The wood is small but is strong and is used for agricultural implements and fuel.

LECYTHIDACEA

82 CAREYA ARBOREA

Local names—Kumbhi (Oriya, Hindi, Bengali) ; Asanda (Ho etc.); kumbe (kondh).

General description—A small or medium-sized, rarely large deciduous tree with a short bole and spreading crown. Bark dark brown, fissured, ½" thick; blaze, red and fibrous. The large obovate leaves are clustered at the ends of the branches. They are 6"—15" long and turn red or purple before falling in February. The large pink and white flowers appear in March—April – May with the new leaves. The green globose fruits are about 3" in diameter. They contain several seeds embedded in a fleshy pulp and ripen in July.

Distribution and habitat—Throughout the province, but chiefly in the moister regions and only found in the valleys in Chota Nagpur. It attains 6 ft. in girth in Angul but no great height. It is frequently found in *sal* forests and rarely in dry deciduous mixed forest, since it favours moist localities with a certain amount of shade. Abundant in the Mals of Puri.

Silvicultural characteristics—The tree stands a fair amount of shade. It is very fire-resistant and is not easily damaged by drought. It coppices freely and coppice shoots grow fairly rapidly. The growth from seed is rather slow. It is particularly liable to injury from browsing, being eaten by cattle and deer.

Uses—The heartwood is dull red, even-grained, moderately hard, heavy and durable. It is soemwhat difficult to season and tends to split. It is little used except occasionally for agricultural imploments and fuel. It is durable under water. If carefully seasoned it would make a good furniture wood as it has a good colour and grain and works easily.

The bark gives a fibre which is used for coarse cordage. It is also beaten out and used instead of cloth by some jungle tribes in Orissa.

83. BARRINGTONIA ACUTANGULA

Local names—Hinjal, hijal (Oriya, Bengali) ; Hyal (Hindi) ; Dundi (Ho) ; Hinjor (Santali).

General description—A small or moderate-sized evergreen tree with dark, rough, furrowed bark and ovate toothed leaves, 9″ by 4″ but usually smaller. Pale pink flowers. with bright red stamens, hanging in long racemes from the tree in May. Fruit oblong, 1″, ripening in September. Blaze, pink.

Distribution and habitat—Throughout the province but only along streams, on the banks of *bandhs* or in swampy localities, frequently with most of its roots immersed in water. It sometimes attains a girth of 5 ft. Most common in the coastal tracts of Orissa; in the Mahanadi delta.

Silvicultural characteristics—The tree is suitable for planting on swampy ground where nothing else will grow. It can be raised fairly easily from fresh seed in soft, wet, muddy soil.

Uses—The wood is white, soft, shining, even-grained and moderately heavy. It shows a handsome silver grain on the radial section. The wood is fairly durable and works easily. It should therefore make a first class furniture wood, if seasoned. Not being a common tree it is little used in this province, but is used for boat-building, furniture, carts and well-curbs elsewhere. The bark contains tannin. It is used for tanning, fish-poison and in medicine.

MELASTOMACEÆ

84. MEMECLYON EDULE

Local names— Niras, nirensa (Oriya) ; dalsundaro (Angul).

General description— A large shrub or small evergreen tree with dark green, shining, ovate, acuminate leaves, 3″— 5″ long by about 2″. Regularly fluted, thin corky, light-brown bark with a hard, deep-brown and then pale-brown blaze ; thin, pink and dirty white in young trees. Flowers, numerous, bright blue, ¼″ in diameter in clustered cymes from the old leaf axils from April to June. Fruit, a small blue or purple berry ripening in June-July. The tree attains about 2 ft. in girth and is very beautiful when in flower. Growth very slow.

Distribution and habitat— Only found in the eastern half of Orissa along rocky-ravines and on the tops of high rocky hills. Rare in Angul; common in Athgarh state and Puri district, especially in Baruni, Sulia and Kuhuri blocks; reemostit of Malyagiri Hill in Pallahara; Baphlai Mali (3,700 ft.), Kalahandi.

Uses— The timber is light-brown, very hard and close-grained Unfortunately it is small and so is only used as firewood. It is a first class fuel and yield excelent charcoal.

LYTHRACEÆ

85. WOODFORDIA FRUTICOSA

Local names— Dhadki (Oriya); dhatuk (W. Orissa), dhaula (Hindi); icha (Ho, Santali); drahni, drohi, druni, pottakalleru, rakhei (Kondh).

General description— A large deciduous shrub with narrow lanceolate leaves, 2½″— 4″ long, and very beautiful when in flower and covered in masses of small red blossoms from January to April. It is leafless from February-March. The fruit ripens from January to April.

Distribution and habitat— This shrub has been included, since it is such a common and conspicuous feature of the forests and waste land of the province. It is common in the plains on clay soils in open forest as second growth and on old abandoned cultivation.

Uses— A red dye is extracted from the flowers. The flowers and leaves contain a good deal of tannin and are used in medicine as a cure for dysentery, etc. The wood, which is reddish white, hard and close-grained, makes an excellent fuel.

86. LAGERSTROEMIA PARVIFLORA

Local names—Sidha (Oriya, Hindi, Bengali); senha, lendia (W. Orissa) ; sekra (Ho, Santali); seina (Kondh).

General description.—A large tall tree, but more commonly a small deciduous tree or large shrub. Bark, smooth, greyish or reddish, stripping off in long narrow flakes in old trees. Blaze, light-brown. Leaves, narrow, elliptic or oblong, almost lanceolate, 2″—3½″ long. The flowers are small, white and sweet-cented and appear in April-May. The tree is leafless from February to March. The fruits are ¾″—1″ long or more, avoid, splitting open in December-January. The seeds including the wing are about ½″ long.

Distribution and habitat—Throughout the province but only reaching a large size in certain localities, e. g., Baghmunda block, Angul. It rarely exceeds 6 ft. in girth. It is typical of dry decidous mixed forest although it also occurs in association with sal. The tree grows on a variety of soils but thrives best on a deep loam. It is often found on clay but will not stand water-logging.

Silvicultural characteristics—The tree is a decided light-demander. It is frost-hardy and stands drought well. It is not browsed by cattle or goats, and this no doubt accounts for its prevalence in many places as a shrub on waste lands or in village forests where it is often gregarious. The tree coppices and polards very well, giving a large number of shoots which grow very rapidly : at least up to a point. The growth of seedlings in moderately fast but they are liable to damage by frost, whereas the coppice shoots are not. Seedlings will not bear heavy shade or a dense growth of grass. It is a good tree to retain wherever it is found in sal forests.

Reproduction—Fertile seed is not produced in abundance every year. Loose porous soil favours natural reproduction, hence the abundance of *sidha* on abandoned cultivation.

Uses—The timber is greyish-brown, darker near the centre, very hard, heavy, strong and durable. It should be used more than it is, but in our area large trees are hardly sufficiently common anywhere for it to be economically important. It can be used for all purposes for which sal is employed including sleepers. It is an excellent fuel and gives a very good charcoal. The poles are used estensively for house-building, rafters and agricultural implements.

Lagerstroemia flos-reginae—(Patuli, *Oriya;* Jarhul, *Bengali*, Garasekre, *Ho*).

A very rare and most beautiful evergreen tree with large purple flowers 2″-3″ in diameter in May-June. It is found wild only along muddy streams in Bonai; along the Brahmani and Mahanadi and in Cuttack and Balasore. There is is a patch close to Chamundia in Daspalla. In our province it is only a small tree, but it reaches a large size in Bengal, Assam, and Burma. Occasionally planted in gardens (The Mahanadi Club, Sambalpur).

CORNACEAE

87. ALANGIUM LAMARCKIA

Local names—Ankula, dolanku (Oriya); akola (Hindi); ankola (Ho); ankil (Sambalpur); akarkanta (Bengali).

General description—A large shrub or small deciduous thorny tree with oblong, lanceolate leaves, 3″—6″ long, puvescent (hariy) all over when young. Beautiful when in flower and covered with white scented blossom. Bark, pale grey ; blaze, cream-coloured. Fruit about ½″ in diameter, black, globose, fleshy with a hard seed. Flowers, March— May, fruit, June-July.

Distribution and habitat—A common tree throughout the province but only locally abundant. Frequent on waste land and in scrub jungle throughout Orissa. It is generally found in dry situations but where the soil is deep and moist it attains a height of 30 ft. and a girth of 4 ft.

Uses—Little is known of its reproduction or silvicultural characteristics. The wood is handsome, the heartwood being olive-brown and scented. It is hard, close grained, seasons and works well. It is an excellent timber when found large enough, and is very suitable for furniture and carving. It is much used for small agricultural implements. An excellent fuel.

RUBIACEAE

88. ANTHOCEPHALUS CADAMBA

Local names -Kadam (Oriya, Hindi, Santali); sanko (Ho); padam (Kondh).

General description—A large, straight, evergreen (sometimes deciduous) tree with spreading branches arranged in whorls. Bark, dark grey, smooth in young trees but rough and fissured in old ones. Blaze, yellow-brown, white on the wood. Leaves, oblong or ovate, 5″—10″ long. Small orange-coloured flowers in globose heads, 1½″—2″ in diameter in May-July. Fruit, large, round, fleshy,2″—2½″ in diameter, containing numerous seeds. It ripens and falls from the tree from August—October. The tree attains a girth of 6—8 ft.

Distribution and habitat—Often planted throughout the province but wild damp cool valleys though rather scarce. It is only found in moist tracts in sal forest and also in the semi-evergreen mixed forests of Puri. It is not met with in dry decidous mixed forest. It is most frequently found on deep well-drained alluvial soil near streams and rivers. Occasional in Angul-Athamallik.

Silvicultural characteristics—The tree is a light-demander, although young plants stand shade well and require protection in their earlier stages. It is very susceptible to drought and frost, especially the seedlings; and young plants are very liable to damage by cattle and deer. The tree has a very rapid rate of growth and coppices vigorously.

Reproduction— Natural reproduction is very good, given favourable conditions, namely light, shade, moisture and newly-exposed soil. The fruit is eaten by cattle, deer and birds and the seed is scattered in this way.

The tree is easy to raise artificially, transplanting being more satisfactory than direct sowing. This is best done in the first rains if the seeds are sown in beds in March-April and kept watered. Transplanting can also be done in the second rains. Care must be taken not to wash out the small seeds from the beds by excessive watering ; at the same time drought must be guarded against.

Uses—The wood is white or yellowish, light soft and even-grained. It is used for tea-boxes, packing cases, light furniture and planking and is said to be satisfactory for match splints. It is not very durable or strong.

89. Adina cordifolia

Local names— Kurrum, halando (Oriya) ; mundi halland (Sambalpur and West Orissa) ; karam (Hindi, Santali); kumba, kurumba (Ho); katha mudring, nonding (Kondh).

General description— A large deciduous tree with a straight bole and spreading crown, frequently attaining 8 ft. in girth or more and a height of 100—120 ft. It occasionally reaches very large dimensions. Bark, grey, or silvery grey, smooth when young, about ½″ thick, soft ; blaze pink, yellow on the wood. The leaves are cordate (heart-shaped), 4″—8″ long and broad. They fall from February—May and are renewed in June. The flowers are in round yellow heads, about ¾″ in diameter appearing in June and July. The fruit-heads are also globose and shed their numerous small seeds when they ripen from February to May.

Distribution and habitat—This tree is found throughout the province both in sal and in dry mixed deciduous forest ; it occurs in fairly dry situations but reaches its best growth in deep fertile soil in moist valley bottoms such as are found in Angul, the Mals of Puri and other parts of Orissa. It is perhaps more frequently found in mixed deciduous forest in damp localities than elsewhere. It is not unusulal to find it growing in distinctly wet positions although its growth under such conditions is usually poor if the soil is at all water-logged.

Silvicultural characteristics—The tree is a strong light-demander, although the seedlings will survive moderate shade and are frequently found under shade in the natural state. The tree prefers a well-drained soil. It is moderately hardy to drought, but seedlings suffer in this respect and require moisture if they are to do well. It stands frost fairly well. Young plants and coppice shoots are very liable to damage by deer, cattle and goats. The bark of saplings and young trees is occasionally gnawed by bison and sambhar. However, the tree has good powers of recovery. It coppices vigorously, producing a large number of shoots which have a rapid rate of growth. The growth of seedlings is also rapid under favourable conditions.

Reproduction—The seeds are extremely small and light and can be carried to some distance by the wind. Natural reproduction is on the whole poor, but is occasionally met with in quite dense patches. It is often found that these are burnt areas and that the seedlings have sprung up in the ashes. A clean bed appears essential for germination; freshly broken well-drained soil being best. The seeds are apt to be washed away by heavy rain. Light shade is favourable.

Direct sowings do not give good results. The seed should be sown in well-drained raised beds and these should be covered with branches or matting raised about one foot above them to give protection from the sun and rain. Seed-boxes are said to be even more suitable (*cf.* Troup, "Silviculture of Indian Trees"), the seedlings being pricked out about 2—4″ apart in the boxes and transplanted in the second rains. Care is necessary in transplanting, a ball of earth being kept round the roots. Precautions against drought must be taken and the earth around the plants kept well loosened. It is advantageous to add some charcoal to the soil in the seed-boxes or seed-beds. (*See* also Howard's "Forest Pocket Book" for further details).

Uses—The wood is yellow, not very hard moderately heavy and even grained. It is used largely for planking and boxes but requires careful seasoning as it is liable to split and warp. It is also used for furniture, turnery bobbins, combs and certain agricultural implements. It takes a good polish and has quite a good appearance. It kiln-seasound it makes excellent bobbins.

90. MITRAGYNA PARVIFLORA

Local names—Mitkinia, mundi (Oriya); guli-kadam, mitkunia (Bengali); karam kaim, kalmi (Hindi); sande-kuma (Ho); guni, amsabita (Mundari); muid (Sambalpur); krambangi (Kondh).

General description—A moderate-sized or large deciduous tree with silvery grey bark, exfoliating in white patches. Rather similar to *Adina cordifolia* in general appearance but the leaves are ovate, 4″—6″ long by 3″-4″ broad, and not cordate; the patchy bark is also more remarkable in this tree. The cole is seldom as long or as straight as *Adina* but reaches quite a large girth, often exceeding 6 ft. The leaves are shed in April-May. The flowers are pale yellow and appear in globose heads about ¾″ in diameter in May-June. They are similar to those of *Adina*, as are also the globose fruits and the seedlings. The blaze is also very similar.

Distribution and habitat—Fairly common throughout the province and found under much the same conditions as *Adina*, being perhaps still more frequently associated with mixed deciduous forest in moist localities. It also occurs as a subsidiary species in sal forest. It requires much the same conditions of growth as *Adina*.

Silvicultural characteristics—The tree is very similar in all respects to *Adina*, but stands water-logging and drought rather better. It coppices freely and grows rapidly. As it coppices from the cambium, it should be cut low.

Reproduction—The notes under this head for *Adina cordifolia* are equally applicable in the case of this tree.

Uses—The timber is yellow in colour and almost indistinguishable from that of *Adina*. It is used for the same purposes but is said not to be quite so satisfactory, having a greater tendency to warp and crack.

91. MORINDA TINCTORIA

Local names—Achhu, acchhi (Oriya); al, ach (Hindi); chiali (Ho, Santali); sali (Mundari), labenkoti, aso (Kondh)

General description—A small deciduous tree up to 25 ft. high and 3 ft. in grith with brown or grey, rough, corky bark having longitudinal cracks. Blaze, grey-brown Leaves, ovate, or eliptic, suddenly pointed at the tip, about 6″ long. The flowers are white, about ¾″—1″ in diameter and sweet-secented. They appear from May—September. Fruit, about 1″ in diameter whitish green ripening in January-February. The twigs are quardrangular in section.

Distribution and habitat—Throughout Orissa ; being locally common in dry type forests often in association with small sal. Common in some of the Khurda forests. It is not so commonly found in the better quality crops in moist localities, but is rather frequent with poor sal on quartzite towards Sambalpur and on sandstone in the north of Angul. It is not of much silvicultural or economic importance.

Uses—The wood is yellow or orange, sometimes with red streaks. It is moderately heavy, fairly hard, even-grained and has a good appearance. It is quite durable but appears to be little used. An orange-coloured dye is extracted from the bark.

92. HYMENODICTYON EXCELSUM

Local names—Guli (Oriya); bhurkul (Uraon), kukurkat, bhaulan (Hindi), bhurkund.

General description—A large straight deciduous tree with whorled branches and large broadly elliptic leaves 4″—10″ long, at the ends of the branches on long stalks. Bark, dark-grey and thick with a soft blaze, pink streaked with white. The small, white, sweet-scented flowers appear in large terminal panicles at the ends of the branchlets in August. The fruits are ovoid, about ¾″ long and ripen in January.

Distribution and habitat—In all forests of the province fairly common, especially in rocky situations. It is more typical of mixed dry deciduous forest, although found with sal. The rate of growth is fast. It coppices well.

Silvicultural characteristics—The tree is a strong light-demande It is sensitive to frost, shade and weeds but it stands drought well

Reproduction—It is difficult to raise artificially, doing best when sown in a nursery, pricked out when 2-3 months old and transplanted in the following rainy season. The seedlings require protection from heavy rain.

Uses—The wood is white when freshly cut, turning grey on exposure. It is soft, light even-grained and not very durable. It is good for planking, packing cases, toys and matches also for turnery.

93. WENDLANDIA EXSERTA

Local names—Tilai, tilo (Oriya); tilai (Hindi) ; hundru (Santali and Ho).

General description—A shrub or small evergreen tree rarely attaining 25 ft. in height or 2½ ft. in girth, with oblong or oblong-lanceolate leaves, 4″—8″ long. The foliage is greyish in colour.

The very small sweet-scented flowers appear in dense masses at the ends of the branches in March-April, when the tree is very handsome. The bark is light brown in colour ; blaze, pink, white on the wood. It fruits in April-May.

Distribution and habitat– Throughout the province except perhaps in the damper parts of Balasore and Cuttack districts. It is commonly found in the dry hill-type sal forests and frequently forms dense gregarious crops in second-growth jungle. It is partial to dry hills and often occurs in hot exposed positions, particularly on land-slips. It is common in all jhumed areas. Rare in west Sambalpur.

The tree is a strong light-demander. The rate of growth is fast and the tree might be useful for reclothing denuded land.

The wood is little used except for fuel, but it is said to be used as house-posts occasionally when large enough. It is reddish-brown, hard and close-grained.

Wendlandia tinctoria– (The same vernacular names) This tree is very similar to the above. It is, however, a shade-bearer and is more commonly found in sal forest in valleys.

94. GARDENIA LATIFOLIA

Local names– Kotranga, damgurdu (Oriya) ; paper papara (Hindi, Mundari) ; popro (Santali); papa (Ho); *benda kurli* (Kondh).

General description– A small deciduous tree with a short, generally crooked bole, smooth pale grey bark and a low spreading crown with large, broadly elliptic or almost round shining leaves, somtimes 15″ long by 6″ broad. The flowers are large, 3″-4″ in diameter, white and sweet-scented. The flowers appear chiefly in April-May when the tree is leafless. The fruits are globose, about 1½″– 2″ in diameter and ripen from December to June. The flowers turn yellow before falling. The buds are protected by a resinous covering.

Distribution and habitat—The tree is most commonly found on dry rocky hills, often on hot exposed positions. It is very frequently seen growing from crevices in rocks where it attains its normal size of about 2 ft. in girth. It is remarkable chiefly for the extremely dry positions in which it can exist.

Silvicultural characteristics—The tree, as already noted, is extremely drought-resistant. It is rarely damaged by fire or forst and is proof against grazing. The rate of growth is slow and it coppices poorly.

The tree can best be raised artificially by transplanting seedlings from the nursery.

Uses—The wood is white or creamy in colour, hard, heavy, even-grained and durable. It works easily for such a hard wood and neither splits nor warps. It is one of the very best woods for carving, engraving or turnery, especially when slowly grown. It is not much used locally except for making combs.

Gardenia gummifera—(*Kurdu*, *kurlu*, *gururu*, Oriya ; *Burui*, Ho). A deciduous shrub, usually about 6 ft. high, with shining leaves 1½″ —3″ long, and flowers similar to *G. latifolia*. It occurs chifly in Orissa, less frequently in Chota Nagpur, but is particularly common is Singhbum, Gangpur state, Sambalpur and the western half of Orissa generally. It is found on the poorest soils and is very drought-resistant, but occurs rather on level ground in waste lands and village forest than on rocky hills where *G. latifolia* is most frequently met with. The wood is similar to *G. latifolia* but as the shrub rarely attains 12″ in girth it is not of much use.

Gardenia turgida—(*Kurudu*, *dhobai*, *kharal*, Oriya ; *dhauuk* Hindi ; *dudni*, *durdi*, Ho). A small straight shrub or tree with a very small crown, smooth white or pale grey bark and sharp straight thorns. Leaves 1″—4″ long. Flowers like *G. gummifera ;* fruit, globose, grey in colour, 1½″—3″ long.

Common on poor soil in dry forests ; most frequently in village scrub and waste land.

The wood is similar to the two foregoing *Gardenias* but is whiter in colour. It has the same properties but being small is not much used. The growth is distinctly slow, the shrub seldom attaining 12″ in girth. It is usually much less.

95. RANDIA ULIGINOSA

Local names—Tolkor, tolok, thelko (Oriya) ; perar (Hindi) ; kumbikum (Ho) ; pendra, pinde (Santali) ; piralo (Bengali).

General description—A small tree with black bark and straggling branches, sometimes thorny. The leaves are 2″—8″ long by 1″—4″ broad, oblong. The solitary flowers are very striking. They are about 2″ in diameter, pure white and scented. The fruit is globose or ellipsoid and about 2″ long. It is green and sometimes yellowish when ripe. Flowers, May—July ; fruit, December—February. Leafless, February—April. The tree rarely exceeds 12″ in girth.

Distribution and habitat—In open scrub jungle in the plains and valleys throughout the province. It is nearly always found in damp or water-logged localities and is often common on black-cotton soil, especially in the south-esat of Orissa in Nayagarh state.

Silvicultural characteristics—The tree coppices and produces root-suckers. It is a moderate light demander. It is very frost-hardy, resistant to drought and does not appear to suffer damage from cattle. The rate of growth is not very fast.

Uses—The fruit is cooked and eaten as a vegetable. The wood is whitish, close-grained and hard, and in many respects resembles the wood of the *Gardeniasi* It is not generally used in our area, but seems suitable for turnery and toys.

96. RANDIA DUMETORUM

Local names—Salara, sarla (Oriya) ; mohana, patua (Sambalpur) ; mainphal (Hindi) ; potua, potab, portoho (Ho) ; peta, sapang (Kondh).

General description.—A shrub or small tree with small oblong leaues 1"—3" long and straight sharp thorns. The leaves are in groups along the branches. Flowers, about 1" in diameter, white, scented and turning yellow before falling. Fruit, an ovoid or globose berry 1"—1" long ; yellow when ripe. The tree varies somewhat in appearance It is leafless in March-April. Flowers, April-June ; fruit, August to January.

Distribution and habitat—Common in the plains and on low hills in dry mixed deciduous forest. Especially common in village scrub jungle in Orissa. It is also frequently seen as under-growth in poor dry sal forests (often on quartzite) and very noticeable in Sambalpur, Rairkhol and the west of Orissa generally.

The tree is very drought-resistant but is rather liable to be browsed by goats. It produces coppice uthoots and root-suckers. The growth is moderately fast, but the tree hardly ever exceeds 12" in girth.

Uses—The wood is white, hard, heavy and even-grained. It is not known to be used, or at any rate is rarely used, in our province except for fuel and fencing. It is said (*cf.* Gamble) to be used elsewhere for agricultural implements. The fruit is used to poison fish, and the bark and fruits are used in medicine.

97. IXORA PARVIFLORA

Local names—Telkurwan, telkurma bhuinkurma (Oriya) ; pete (Ho) ; rangan (Bengali) ; kota gandhol, lohajangia (Hindi) ; merom nut (Santali).

General description—A small evergreen tree or shrub with polished, dark green oblong leaves, 3"—6" long by about 1"—2". Flowers, sweet-scented, small, white in compact panicles from March to May. The small black shining globoes fruits ripen in May-June. It sometimes attains 18" in girth but seldom exceeds 12—15 ft. high.

Distribution and habitat—The tree is common along *nalas.* It occurs in all types of sal forest except the very hilly type and also in mixed deciduous forests, but rarely far from a stream or dry *nala* bed.

The branches are used as torches when green and the fruit is said to yield an inferior oil for burning. The wood is light brown, smooth, very hard, heavy and close-grained. Owing to its small size it is rarely, if ever, used.

SAPOTACEÆ

98. MADHUCA LATIFOLIA

(*Syn. Bassia latifolia*)

Local names—Mohul (Oriya) ; mahua (Hindi) ; madkom, mandukam (Ho, Santlai) ; irida, poyer, pui (Kondh) ; the fruit is called *Kuindi* (Ho, Sanatli) and *kochra* (Bengali). The oil is known as *dola* or *kuindi sunum* (Ho, Santali) ana toli, tolo or tul (Oriya).

General description—A large deciduous tree with a dense rounded crown, spreading branches and a short bole, often 6 feet in girth and sometimes more. The bark is about ½″ thick, grey-brown, not very rough but with vertical cracks. Blaze, thin, brown then thick and red showing latex tubes from which drops of white juice (latex) exude. Leaves large 5″—8″ long by 2½″—3½″ broad, elliptic or oblong and rather rough. The new leaves are brownish-red in colour. The tree is generally leafless from March to May, the new leaves appearing in May. The brown flower buds are first seen in clusters at the ends of the branchlets in January or early February and open chiefly in February and March up till April. The flowers are ovoid, about ¾″ long, creamy white in colour and fleshy. They have an unpleasant odour and are sweet to taste. The fruit is an ovoid drupe, 1—2″ long with a green fleshy covering and a shiny brown ovoid seed about 1″ long. It sometimes contains as many as 4 seeds. They ripen in June-July. The trunk of the tree is often covered in knobby growths caused by incisions made in order to induce the tree to flower heavily.

Distribution and habitat—The tree is common throughout Orissa, except in the south-east from Angul to Puri where it occurs less frequently. It is remarkably absent on the plateau (3,000—3,500 ft.) of Kasipur in Kalahandi state, although common enough on the plains below. It is a conspicuous feature on arable lands in many districts where it is retained for its flowers and fruit. Many, if not most of these trees are survivors from the original jungle which was cleared to make way for cultivation ; for in areas which have been under the plough for several centuries, the tree is rare or etnirely absent since it is seldom planted by the villagers.

It is commonly found in association with sal and also in dry mixed deciduous forest but does not favour damp types nor is it common in the driest exposed rocky mixed forest.

Silvicultural characteristics—The tree has a strong spreading root system but not a very deep one. It is a light-demander but tolerates and benefits by moderate shade in youth. It is fairly drought-resistant and normally stands frost well. The seedlings and young plants are very liable to damage by cattle, deer and goats. It coppices moderately well when small, the shoots showing more rapid growth than those of sal. The growth of seedling is very slow. The tree is liable to attack by *Loranthus* and may die if badly infested.

Reproduction—Natual reproduction is not generally very abundant. Artificial propagation may be done by direct sowing or by transplanting ; direct sowing in lines being preferable for forest purposes. The seed should be covered to a depth of about ½″ and the plants protected from deer and cattle. Watering should be carried out sparingly and the soil kept loose. The seeds, which should be sown in July, germinate in about 10 days. The rate of growth is very slow: not more than 2—3 ft. in three years.

Uses—The timber is reddish-brown in colour, very heavy hard, tough, strong and durable. It is very difficult to work and saw. It is of good quality and suitable for a variety of purposes but the tree is seldom felled owing to the value of its flowers and fruit. It is, however, used to some extent (usually dead and dry trees) for oil-mills, naves of wheels, planks, house-posts and agricultural implements. It is difficult to season and tends to split.

The flowers are the most important product of the tree, their fleshy corollas, which are rich in sugar, being widely used as an article of food, especially by the jungle tribes. They are eaten fresh but are most usually cooked with rice and eaten after they have been dried in the sun. They are of great importance in times of famine. They are also consumed in large quantities by animals, especially bears. When dried, the corollas are pleasant to eat, having lost their unpleasant pungent odour in drying. An intoxicating spirit(*daru*) is also distilled from the flowers. They were used for the production of acetone during the war and have been considered as a possible source of "power alcohol".

The unripe fruits are cooked and eaten. The seeds yield a greenish-yellow oil which is used for cooking and burning. It is also used in the manufacture of soap, margarine and glycerine and for adulterating *ghi.*

EBENACEÆ

99. DIOSPYROS MELANOXYLON

Local names—Kend, kendu, (Oriya, Bengali) ; tend, tendu (Hindi) ; tiril, terel (Ho, Santali) ; duri duringi (Kondh).

General description.—Usually a small or moderate-sized, rarely a large tree. Deciduous or evergree according as it grows in a dry or a damp locality. It occasionally reaches 6 ft. in girth or even more with a straight bole, but more generally it has a short stem and a rounded branchy crown. The bark is black and rough with rectangular plates or scales ; blaze, yellow. The leaves are broadly ovate, 4″—8″ long, rather rough, shining above, usually greyish-green below. The small flowers appear in May. The globose fruits are about 1″ in diameter and turn yellow when ripe in May following the flowering. The male and female flowers are separate. The young leaves are softly pubescent (hairy) and a delicate pink colour.

Distribution and habitat—The tree is one of the commonest in Orissa, especially in scrub jungle and waste land, the letter being frequently covered with a dense growth of small *kendu* plants arising from root-suckers. It also occurs in high forest both with *sal* and dry mixed deciduous species. It is found on hot dry hill slopes and in moist valleys (where it attains its maximum size) and is thus one of our most tolerant and widely distributed species.

Silvicultural characteristics—This is one of our hardiest trees It stands shade well in its early stages but requires more light for its full development. It resists drought and frost extremely well. It is immune to grazing and browsing. It will grow on the poorest of soils and even on fairly heavy clays although it does not attain a large size. It coppices and produces root-suckers freely but the rate of growth is exceedingly slow. It develops a long tap-root at an early stage.

Reproduction—The tree grows readily from seed, direct sowing being preferable to transplanting. The seedlings are senstive to excessive damp. Natural reproduction is often plentiful.

Uses—The timber is reddish-brown with a small black irregular heartwood, which is rarely of utilizable size except in trees of over 5 ft. in girth. It is very hard, heavy and some-what brittle. It takes a good polish and can be used for carving and ornamental purposes. The wood is rarely as black as the true ebony (*D. ebenum*), being usually streaked with brown. It is also suitable for tool-handles.

The poles are used for small village huts. When burnt, the wood emits showers of sparks and is known as "*chirchiri*".

The fruit is edible and is palatable.

The young leaves are collected (chiefly from root-suckers in waste lands) and are used for wrapping *birhis*, the local cigarette. A considerable business is done in these in Sambalpur and the neighbouring districts.

100. DIOSPYROS EMBRYOPTERIS

Local names—Makhar-kendu (Oriya) ; makha-tendu, kala-tendu, gab (Hindi) ; garà-tiril (Ho) ; makha-kendu (Santali) ; phataduri (Kondh).

General description—A moderate-sized, often a large ever-green tree with low spreading branches and a short bole. It frequently attains 6 ft. in girth or more in favourable localities. The leaves are 6″—9″ long, narrow, lanceolate and shiny. The flowers are white and sweet-scented, the female flowers being about 1″ in diameter. The fruit is globose, about 2″—3″ in diameter and covered in a soft red velvety skin. It contains 5—8 seeds in a soft pulp. The flowers appear in April-May and the fruit ripens the following April. The new leaves are put forth about April and are bright red in colour. The bark is black and smooth, or sometimes greensih-grey.

Distribution and habitat—Common throughout the province along streams, especially in shady ravines. Very frequent in Puri and other parts of Orissa, but rather rare in the west. It is most common and reaches its largest size in damp semi-evergreen forest but is found in dry sal forests along *nala* beds.

Silvicultural characteristics—The tree is a decided shade-bearer, often growing under a heavy canopy. It requires a good deal of moisture although capable of growing on dry soils. It will stand very damp soil and will even grow with some of its roots in water. It is fairly sensitive to fire, at least in its younger stages. It coppices when small and produces root-suckers. The rate of growth of seedlings is slow. The seed is disseminated by birds and animals, which feed on the ripe fruit: especially monkeys and fruit bats. The seedling develops a strong tap-toor.

Reproduction—The seeds germinate readily in moist soil and dense natual regeneration is frequently found in patches along streams. If they are exposed to the sun on the surface of the ground the seeds seldom survive, but if buried the seedling grows readily. Under artificial conditions the tree grows readily from transplants in the first or second rainy season, provided the tap-root is not injured. Shade and moisture are necessary.

Uses—The wood is reddish-grey in colour with darker streaks. It is fairly heavy, moderately hard and close-grained. The wood is hardly ever used. The bark is said to be used medicinally. The fruit is eaten by animals and birds ; its pulp is said to be used for book-binding and for caulking boats.

101. DIOSPYROS MONTANA

Local names—Halda (Oriya) ; bis tendu (Hindi) ; sara tiril (Ho) ; gada tiril (Santali).

General description—A small or medium-sized tree, rarely attaining 4 ft. in girth, having a straight stem with smooth greensih bark and a light crown. The bark peels in thin papery flakes and has a very distinctive blaze ; pale yellow or white when fresh changing rapidly to deep yellow and orange. Leaves, ovate-oblong, 2″—6″ long. Male flowers, small, greenish ; female flowers, about ½ in diameter, appearing from April to June. Furit like that of *D. melanoxylon*, about 1″ in diameter greenish-eyllow, turning black when ripe in December-February. The tree rarely exceeds 40 ft. in height and is usually less. It sometimes carries spines.

Distribution and habitat—The tree is widely distributed throughout the province, although nowhere very abundant. Haines state that it is usually found near *nalas*, but it appears to be common throughout all hill forest except in the driest localities. It occurs in association with *sal*, but is perhaps somewhat more frequently met with in dry mixed deciduous forest.

Silvicultural characteristics—Little is known about this tree. It coppices freely and appears to grow fairly rapidly. It is a moderate shade-bearer, occurring chiefly in the second storey of high forest. The seedlings tolerate fairly heavy shade but grow slowly.

Uses—The wood is greyish-yellow, sometimes streaked with brown. It is moderately hard, not very heavy, even-grained, works easily and is durable. It is little used in this province except for building small huts. Its small size is against its more extensive use, but the wood appears suitable for many purposes. The fruit is used to poison fish. The bark when chewed gives the same red colour as "pan"

OLEACEÆ

102. NYCTANTHES ABOR-TRISTIS

Local names—Gangseoli (Oriya) ; kharkhasa, sihara (Sambalpur and West Orissa) ; harsinghar (Hindi) ; saporom (Ho, Santali) ; sitik, sephalika (Bengali) ; dokkedi (Kondh).

General description—A large deciduous shrub, sometimes a small tree with drooping quadrangular branches and very rough leaves. The leaves are ovate, about 3″—5″ long and pointed at the tip. The flowers are white with an orange centre, about ¾″ in diameter, opening in the evening and dropping from the tree next morning. The flowering season is September-October. The fruit is a capsule about 1″ in diameter which ripens in December-January. The bark is grey and rough.

Distribution and habitat—Throughout the province ; very common on dry rocky hills in mixed deciduous forest. Not generally so common is *sal* forests. In many places it forms a dense, gregarious, impenetrable under growth. Not found in damp localites. Frequent in second growth jungle.

Silvicultural characteristics—The tree bears a moderate amount of shade. It resists drought and frost well and is not browsed by cattle or goats. It coppices freely and produceds root-suckers in abundance. It has a spreading root system and is useful for growing on steep slopes to stop erosion.

Uses—The wood is pale red in colour, moderately heavy, hard and close-gained. It is an excellent fuel. The leaves can be used in place of sandpaper for polishing wood. A perfume and an orange dye are extracted from the flowers. The fruit is used medicinally and the root is said to be eaten.

103. SCHREBERA SWIETENIOIDES

Local names—Mokha, mukha (Oriya) ; Gae ka lundi (Hindi) ; Sandapsing (Ho) ; Akasara, ekasira (Santali)

General description—A moderate -sized deciduous tree, rarely exceeding 4 ft. in girth with pale grey nearly smooth thin bark, exfoliating in thin scales and having a pale brownish-yellow blaze Leaves, compound with 3—7 ovate leaflets, 3″—7″ long. The white flowers appear in panicles at the ends of the branches in May-June with the young leaves and are covered by brown scales. The fruit is a pear-shaped capsule about 2½″ long ; it ripens from October to March. The tree is leafless from February to the end of April.

Distribution and habitat—Locally common in the hills of Orissa. It is found in association with sal, but is much more frequently met with in dry mixed deciduous forests. It is rather more common in the west towards Sambalpur and Patna than elsewhere. It perfers dry localities.

Silvicultural characteristics—The tree bears some shade, but is better described as a moderate light-demander. It stands drought well but is sensitive to frost. It coppies freely and produces root-suckers. The rate of growth is moderate.

Uses—The timber appears to be of good quality but is little used in our province except for building small huts. It is brownish-grey, hard, heavy, close-grained and durable. It is said to be suitable for combs, toys and turnery and it is thought it might be fit of shuttles.

APOCYNACEÆ

104. HOLARRHENA ANTIDYSENTERICA

Local names—Korai, kuda, khurni (Oriya) ; kurchi (Hindi, Bengali) ; kuar, tuar (Ho) ; Hat (Santali) ; palasi, palsi (Kondh).

General description—A deciduous shrub ; rarely a small tree attaining on occasions a girth of 2½ ft., or even 3 ft., with thick, smooth, greyish, scaly bark. Blaze, brownish, exuding a white latex. Leaves, elliptic-oblong, 6″—12″ long by 1½″—5″ broad with prominent nerves. Flowers, about 1″ in diameter, white and sweet-scented, in terminal cymes, from May to July. Fruit, 6″—9″ long and very slender, containing numerous light-brown seeds (*indrajao*), to which are attached pale brown silky hairs They ripen from December to February.

Distribution and havitat—Very common in all districts, chiefly in scrub jungle and waste lands. It also occurs in sal and mixed deciduous forests. It is generally more common in dampish localities but occurs in dry positions and is abundant on bare laterite in Khurda. The tree is important for clothing waste lands. It is commonly found in small clearings in sal forests.

Silvicultural characteristics—The tree is a light-demander but will stand light shade. It is rather easily affected by frost but stands drought well. Seedlings are tender in both respects. It is not touched by cattle or goats. It coppices very freely, produces root-suckers and speedily recovers from damage by fire. The rate of growth of coppice is hardly inferior to *sal* up to 9 years of age, after which it is slow.

Reproduction—Natural reproduction is generally good, where seedlings are not killed off by drought. It can be raised artificially without difficulty by direct sowing or transplanting. The plants benefit by weeding and by having the soil loosened.

Uses—The wood is white, soft, and even-grained. It is not much used locally owing to its small size but is suitable for match splints and for toys, where large enough.

The bark and seeds (indrajao) are extensively used as a cure for dysentery.

105. ALSTONIA SCHOLARIS

Local names—Chhatian, chhatni (Oriya); chatawan (Hindi) ; kunumung (Ho) ; chatni (Santali).

General description—A large and rather striking evergreen tree with a tall straight, butterssed stem, whorled branches and dark green shining leaves, also in whorls. The tree attains a height of 100 ft. and a girth of 6—8 ft. One measured in Malyagiri block, Pal-Lahara state, was 11 ft. 3 in. in girth. The leaves are 4″—8″ long. The flowers are greenish-white in panicles and appear in December-January. The fruits are 1-2 ft. long and slender, ripening in July and August. The bark is pale grey and smooth, blaze, hard, brown and cream, then white with a copious flow of milky latex.

Distribution and habitat—The tree is nowhere abundant although met with in almost all the Orissa districts, where it in damp shady localities. The most usual site in which it is found is close to a perenuial stream at the base of a ravine, where it often forms a small—group.

It has been mentioned here more in view of its fine appearance than on account of its importance or its frequency.

Silvicultural characteristics—It appears to be a shade-bearer with a preference for damp soil. It grows very rapidly from coppice or seed.

Uses—The wood is white, soft, light, easily worked but not durable. It soon discolours unless carefully seasoned in the plank. It does not appear to be used in this province, but Gamble states that it is used for "boxes, furniture, scabbards and other purposes and is made into black-boards in Burma". The bark is used medicinally.

LOGANIACEÆ

106. STRYCHNOS NUX-VOMICA

Local name—Kuchila (Oriya, Bengali).

General description—A large, almost evergreen tree attaining a girth of 5 ft. with pale, smooth, grey bark more usually a small crooked tree on laterite in waste lands and "protected forests", where it most commonly found. The leaves are broadly ovate, shiny, about 2″—4″ long, with 5 prominent nerves. The new leaves appear in March. The small greenish-white flowers appear in March-April. The fruit is globose, 1″-2″ in diameter, orange coloured and in appearance like a small orange. It has a hard covering and contains several satiny, silvery seeds about ½″ in diameter, like buttons, in a bitter white pulp. The fruits ripen in December-January.

Distribution and habitat—Wild in the south-east of Orissa only. Very common in Puri, Cuttack and Balasore districts and in the states of Ranpur, Nayagarh, Athgarh, Kahandpara, Daspalla, Baramba and parts of south-east Dhenkanal. It extends along the banks of the Mahanadi as far as the Barmul gorge in Angul and is not found (or very rarely) west of this. It occures sparingly in the south-east corners of Keonjhar and Mayurbhanj. It is not found in any abundance in high forest but forms gregarious crops in scrub jungle, on waste land and in the so-called "protected forests' of Khurda. On the very shallow laterite soils of Puri and Cuttack it is often the only tree which has survived the ravages of man and the incessant pasturing of goats.

Silvicultural characteristics—The tree bears moderate shade. It resists drought well but is easily damaged by frost. It is not injured by animals. It coppices well and produces root-suckers. The rate of growth is moderate. No experiments appear to have been recorded having regard to its reproduction, but it appears to regenerate freely under natural conditions.

Uses—The wood is white when freshly cut, turning greyish or greyish-green on exposure. It is hard, heavy, tough, durable and rather cross-grained. It is not attacked by white-ants. Owing to the value of its fruits the tree is rarely felled for timber.

The seeds are important economically as the source of strychnine and brucine, and are exported in considerable quantities. The buck of the world's supply of strychnine is manufactured by Messrs. Smith Stanistrent of Calcutta.

The bitter pulp is eaten by Langur monkeys (Hanuman) and by hornbills (*kuchila khai*).

107. STRYCHNOS POTATARUM

Local names—Kotokol (Oriya) ; nirmali (Hindi) ; koya (Sambalpur). The clearing nut.

General description—A small almost, evergreen, branchy tree with rough, black, much cracked bark and elliptic or ovate leaves 1½″—5″ long, rather similar in appearance to those of *kuchla*. The small white flowers appear in dense cymes in the axils of the fallen leaves in May. The green globose fruit is about ¾″ in diameter and ripens from October to February.

Distribution and habitat—Throughout Orissa, but rare except in some of the Angul protected forests near Purnagarh where it is quite common on rocky hills in scrub jungle. It is also locally fairly abundant in some of the scrub jungles of Puri. It is not found in association with sal, but in dry mixed deciduous forest often of a semi-evergreen type.

The tree stands moderate shade and resists drought well. It coppices and produces root-suckers. It is not of importance silviculturally.

Uses—The wood is white when freshly cut, turning grey on exposure ; hard, heavy, close-grained and durable. It is a good timber but rarely large enough to be of any use.

The fruits are not poisonous and are used to clear muddy water, the seeds being first rubbed round the inside of a vessel.

BORAGINACEÆ

108. CORDIA DICHOTOMA

Local names—Gondi, dhuanl, guhalo (Oriya) ; hemrum (Ho) ; Buch (Santali) ; lasura (Hindi) ; (Syn. Cordia myxa) ; bohari (Bengali) ; bahalphal (Sambalpur).

General description.—A small crooked, almost evergreen tree wit. drooping branches, ashy-coloured twigs and round or obovate shiny leaves 2½—5″ long. The bark is greyish-brown, smooth or slightly wrinkled Blaze, white, turning, brown on exposure to the air. Flowers small, white and scented, in cymes, usually at the ends of the short lateral branches in March-April. The fruit is a yellow or pinkish shining berry about ¾″ in diameter, containing one seed. It ripens in July-August. A pretty tree when in flower.

Distribution and habitat—Occurs rather sparingly througout the province, not gregarious anywhere. It is more abundant in the damper districts or along shady ravines in the dry ones. It is more typical of mixed deciduous than of sal forest.

Silivicultural characteristics—The tree is a moderate shade-bearer. It stands frost and dought well and rapidly recovers from injury by fire . It coppices well and grows moderately fast, but the rate of growth is slower than *sal* coppice. The growth of the seedling is also fairly rapid.

Reproduction—The fruit stones should be sown in a nursery in June-July lightly covered with earth and regularly watered. They can be transplanted without difficulty in the following rains. Pruning of the stem and root is advantageous.

Uses—The wood is greyish-brown in colour and moderately hard but is not durable. It is said to be used for agricultural implements and as fuel. The bark yields a fibre which is used for cordage. The fruit is used as a cure for coughs.

Cordia macleodie, Ghanti (Oriya) ; Sumbhar-Singha (Sambalpur) ; turai (Gangapur) ; is probably commoner then C. dichotoma and is very abundant in western Gangpur (Athkosia forsts) on granite-gneisses and schists. A shrub or small tree with very tough wood.

BIGNONIACEÆ

109. MILLINGTONIA HORTENSIS

Local names—Bakeni, reali (Oriya) ; akas-nim (Hindi) ; Indian Cork tree.

General description—A tall handsome tree often 120 ft. high with a narrow crown and compound leaves 1—3 ft. long, having leaflets 1″—3″ long. Large panicles of white, scented flowers appear from October to December ; they are 2″—3″ long. The fruits is a slender capsule about 12″ long.

The tree does not occur wild in our area but is very commonly planted in gardens and avenues. It is liable to be thrown by the wind owing to its great height and shallow root system. It gives numerous root-suckers . The wood is yellowish-white, soft and not used in our province. It is suitable for packing cases if well seasoned.

110. STEREOSPERMUM SUAVEOLENS

Local names—Boro-patuli , padal, parhel (Oriya) ; parul (Bengali) ; husi (Ho) ; padar (Hindi, Santali) ;

General discription—A moderate-sized or large deciduous tree with smooth grey bark (scaly in large trees) ; blaze, pale yellow, in hard and soft layers. The large compound leaves have 5 —9 broadly elliptic or oblong leaflets, pointed at the tip 3″—7″ long by 2½″—3″ broad. The flowers are crimson, streaked with yellow, 1″—1½″ long, sweet-scented and are borne in large panicles in April and May. The fruit is a slender capsule, about 18″ long by ¾″ in diameter and is usually spirally shaped. It splits on the tree when ripe from September to February and sheds its numerous small winged seeds.

Distribution and habitat—The tree occurs commonly thoroughout the province in mixed deciduous and sal forests, being a frequent accessory species in the latter. It is often found in grassy blanks in the forest and is a suitable species for reafforesting such areas. The tree grows under a variety of conditions and soils but on the whole appears to prefer dry localities. It will grow on clay as well as sandy soil. It attains its best growth in valleys in the hills, where it sometimes reaches a girth of 6 feet.

Silvicultural characteristics—The tree is a moderate light-demander. It is very fire-resistant, stands drought well and is very hardy as regards frost. It is rarely damaged by cattle or goats. It coppices freely and grows rapidly : more rapidly than sal coppice. The rate of growth of seedlings is moderate.

Reproduction—Under natural conditions reproduction is often abundant, especially on dry hillsides or freshly exposed soil. The tree can be raised artificially without difficulty by direct sowing. Transplanting is best effected in the second rainy season, using root-and-shoot cuttings.

Uses—The sapwood is grey and hard ; the heartwood is small and yellowish-brown mottled with darker streaks and very beautiful. It seasons well and takes a good polish. The wood is durable and easy to work. It is said to be used to some extent for building but is in little demand in our area. It is a good fuel and yields a high grade of charcoal. This tree is very suitable for reafforestation work owing to its tolerance in respect of conditions of growth, its resistance to external damage and its useful timber.

VERVENACEÆ

111. CALLICARPA ARBOREA

Local names—Konso, boro patri, san gamhari (Oriya) ; bomud, bodudn (Ho) ; Dam kotokoi (Santali) ;

General description—A small or moderate-sized evergreen tree with quadrangular branchlets, and light, sandy-coloured, smooth bark. Blaze, soft, white with yellowish streaks. The leaves are ovate-oblong, pointed at the tip and 6″—12″, by 3″—5″ hairly beneath. The flowers are purple, small, in corymbose cymes, in October and from April to June. The fruit is a small purple berry which ripens from August to January. The tree sometimes attains a girth of 3 ft.

Distribution and habitat—Throughout the province, generally in moist localities or on shady aspects, in ravines, near streams, etc. No where very common except in the Mals of Puri. Frequent in the Kalahandi hills the tree is a strong light-demander and grows rapidly.

Uses—The wood is brownish-white, light, moderately hard and even-grained. It slightly resembles the wood of *Gmelina arborea* but is only used as fuel and charcoal.

112. TECTONA GRANDIS

Local names—Saguan (Oriya) ; sagun (Hindi) ; rang (Ho) ; teka (Gondi) ; Teak.

General description—A large deciduous tree with a light grey-brown bark, trunk sometimes fluted, quadrangular branchlets and a rounded crown. In Burma and South India, it attains a height exceeding 150 ft. and a girth of 10 ft. or more. A tree recorded from Coorg measured 192 ft. in height ; 114 ft. to the first branch ; girth at 4½ ft., 15 ft. 10 ins. Under natural conditions in our province it rearely exceeds 50 ft. in height, with a short bole and branching crown. A girth of 6-7 ft. is, however, sometimes reached but the average is about 4 ft. Th e growth in the Puri plantations is much better and it is probable that a height of 100 ft. and a girth of 6-7 ft. will be reached in 70—80 years.

Trees have been recorded having a stem timber volume of over 800, and even 1,000 cubic ft. One log recorded from Yamathin district of Burma had a lenght of 64 ft., a mean girth of 13ft. 9 in. and a volume of 756 cubic ft. Such enormous trees are, of course, rare and are becoming yearly more so.

The leaves are very large, 1-2 ft. long, elliptic or obvate, very rough above and somewhat tomentose beneath. They fall in December-January and the tree is generally leafless until May. The small white flowers appear in large terminal panicles 1-2 and sometimes 3 ft. long in July and August, when the tree is very conspicuous. The fruit is a hard, bony, globose nut, usually about ½" in diameter, with a light-brown felt-like covering. It ripens in the cold weather from November to January and falls from the tree, some remaining until the hot weather. The fruit contains 1—3, rerely 4, seeds.

Distribution and habitat—Teak occurs naturally only in the west of Orissa along the borders of the Central Provinces. Apart from a very small patch in Baudh and Sonepur near Ghantapara on the banks of the Tel river, and another in Lachmidungri near Sambalpur, the main area commences in the south-west of Patna and north-west of Kalahandi and extends thence through Khariar in the south-west of Sambalpur district. It also occurs as a narrow fringe in Malkangiri (Jeypore) along the borders of Bastar State. This area constitutes the easterly limit of the teak tree in India and forms part of the Central India Teak region. In the main area the teak is found chiefly in small scattered patches on alluvial land amidst cultivation in the basin of the Tel river, or on low rocky hills in reserve forest. These areas have been very heavily exploited in past times and are now in poor condition for the most part.

They are said to have yielded many large trees. In this area teak is found chiefly in mixed deciduous forest in association with the common bamboo (*Dendrocalamus strictus*), *Schleichera trijuga, Odina wodier, Pterocarpus marsupium, Mitragyna parvifiora, Terminalia tomentosa,* etc. A little *sal* also occurs in the teak area.

Outside this limited area there is no natural teak in the province but plantations have been made in Puri, Angul, Panta and Nayagarh. Other small plots have been planted elsewhere, and it is sometimes met with as a roadside tree. The Puri and Angul plantations are the most important and also the most successful, covering in all an area of over 4,340 acres. It has been found that the best results are likely to be obtained on well-drained alluvial soil in valleys, on areas that are frequently covered by the thorny bamboo (*Bambusa arundinacea*). In the Barbara plantation of Puri, which was started in 1906 and now covers 3,000 acres, an average crop height of 99 feet 3½ inches with an average girth of 71 ins. has been obtained in 42 years ; the maximum height in this area being 107 ft. 7ins. and the maximum girth 7 ft. 8 ins. Seeing that the original 1906 crop was interplanted 8 years later, the average of the crop is actually less than 25 years. These measurements correspond with I Quality in the Nilamabur Teak Plantations of Malabar. One tree measured in the 1906 plantation was 6 feet 3 inches in girth at 4½ feet from the ground. It was, admittedly, receiving more light than the average and was somewhat branchy. The rainfall at Barbara is about 60″ and the relative humidity and mean minimum temperature are high. This plantation was badly damaged by a cyclone in 1937.

Silvicultural characteristics—Teak is a very strong light-demander, the seedlings being very intolerant of shade or suppression by weeds. It will grow on a great variety of soils but good subsoil drainage is essential. The tree forms a strong and deep root system, the seedling developing a tap-root of 12″ or more in the first season. Teak is readily damaged by frost, seedlings being particularly susceptible to injury from this source. The tree resists drought well but the seedlings suffer in this respect. Both tree and seedlings are remarkably resistant to fire, the latter soon recovering and sending out new shoots, if damaged. Neither deer, cattle nor goats injure the plants seriously but some damage is done in plantations by bison and elephants. Teak poles are sometimes stripped of their bark by bison and sambhar. Rats and pigs are said to do some damage in plantations elsewhere, but non has yet been observed in our area.

Loranthus is very prevalent in the Buchundabogra plantation in Angul but has not been noticed elsewhere. The trees are defoliated almost annually by aterpillars (*Hybloea puera* and

Pyrahster machaeralis) but otherwise the trees in our area do not appear to be affected by the more serious insect and fungus pests met with in Burma and elsewhere.

Teak coppices and pollards extremely well, giving coppice shoots up to quite a large girth. The best months for coppicing are said to be April and May. The rate of growth of coppice is very rapid provided the plant has plenty of light.

Reproduction: Natural—Teak does not regenerate well in cool shady places, hence good natural reproduction is not to be expected under a dense canopy, where the seed may lie dormant for years. The best results are obtained by burning the soil covering breaking up the soil, slightly covering the seeds and opening the canopy to admit light. The success of this procedure was well demonstrated in natural teak forest near Bakbahal in Patna in 1928—30, where a dense second story of *salia bans* (*Dendrocalamus strictus*) occurred under a light canopy of teak, *kusum*, *piasal*, etc., with a little sal. The removal of the bamboos and undergrowth by cutting and burning over two successive years resulted in the teak regenerating itself in dense patches over the cleared area and rapidly becoming established. It is generally held that fire plays an important part in inducing reproduction. Apart from clearing the grass and undergrowth it is believed to stimulate germination. It is to be noted that once the seedlings appear, they benefit from fire protection *in dry forests*.

The follwing very interesting figures have been taken from Troup's "Silviculture of Indian Trees " and demonstrate clearly the effect of fire protection on regeneration. They relate to natural teak forest in Tharawaddy, Burma, where moist conditions prevail, somewhat similar to those in Barbara in Puri. The number has been calculated for 50 acres in each case:—

Class		Fire-protected plot	Un-protected plot.
I. Poles 1—2 ft. in girth.	(*a*) Sound ..	174	135
	(*b*) Unsound and dead	109	29
II. Saplings under 1 ft. in girth.	(*a*) Sound ..	24	141
	(*b*) Unsound and dead	121	37
III. Seedlings ..		62	616

The difference between the number of sound and unsound saplings and seedlings in the two plots is very striking and speaks for itself. The number of dead poles and saplings in the protected plot is due to suppression.

After the teak has established itself, it is of the greatest importance that it should be kept free from suppression by grasses, shrubs, etc., and that the canopy should be thinned to admit sufficient light to permit of its development. Although saplings may exist for some time under light shade of bamboos, they will not develop fully and are very liable to have their tops damaged.

The effect of light and the absence of weeds on reproduction is obvious from the large number of teak seedlings that are often seen in borrow-pits along roadsides where teak trees have been planted, Similarly there is a small teak plantation in the Santal Parganas division in the neighbourhood of which excellent regeneration exists in an exposed position. In the Puri teak plantations seedlings are rarely found owing to dense shade and weeds.

B. Artificial—(*i*) The site of a teak plantation should be carefully selected. Good drainage is essential and a deep alluvial soil is best. Laterite should be avoided.

(*ii*) The spacing most usually adopted is 6′×6′ in Burma. In Nilambur it is 8′×8′ on good soil and 6′×6′ on soils of poor quality. A spacing of 6′×8′ is prescribed for regular plantation in Puri and a spacing of more than 8′×8′ should be avoided in regular plantations not carried out together with field crops. In "taungya" plantations in Puri, however, where ploughing between the lines is carried out, the working plan prescribes the lines to be 12 feet apart with the plants 6 feet apart in the lines.

(*iii*) It is necessary to prepare the seed before sowing if high percentage of germination is to be obtained. This can be done by burying the seeds in a hole in the ground in April and watering them heavily every third day for six weeks. The seeds are then spread in the sun for three weeks after which they are ready for sowing. Similarly, they may be buried in a heap of stable refuse or straw and watered in the same way. Soaking in warm water for 24 hours before sowing is said to produce good results. Seeds placed between gunny bags in April and kept moist, germinate rapidly and may then be sown. There are several similar devices for accelerating germination.

(*iv*) The seed should be sown about $\frac{1}{2}''$ deep. Seeds must not be sown deeply.

(*v*) Seed sown in the nursery should be covered with straw and watered copiously daily. When germination takes place in 10 to 20 days, the straw should be removed.

(*vi*) Teak may be sown direct (usually in mounds), or seedlings may be transplanted from the nursery, or even from the forest. Probably the best method is to utilize "root-and-shoot" cuttings. which may be prepared as follows. Seedlings are raised in the nursery. At the end of the first rains they will be about 7″ high. At the commencement of the second rains the root-and-shoot cuttings should be prepared and put out. If properly tended they should be 5—6 ft. high at the end of the rains. This method gives excellent results and is recommended for all plantation work. To make the cuttings the stem should be cut down-to 1—2″ and the root to 9—12″ in length.

(*vii*) The "taungya" or toila" system of raising teak with field crops is so much cheaper than any other method and gives such good results that it should be employed wherever possible. This system has been practised in Puri with goodresults. As noted above, a spacing of 12′×6′ seems most suitable. Very briefly the details of the system are as follows:—An area of jungle is felled and when dry is burnt. The fire should be fierce so as to consume the *debris* completely. The cultivators to whom the land has been temporarily granted, cultivate the area and raise dry crops (usually upland paddy, millet or pulse) during the first rains. During the second monsoon the villagers again sow crops and with them the teak plants are put out but it is better done in the first year, if this can be arranged. Weeding is done by the cultivators who receive a reward according to the success of the plant. They then move on to a fresh area in the following year. It is usually necessary to carry out weeding in the third year, but this will depend on circumstances.

(*viii*) Boradcast sowing was tried in Patna State but did not meet with much success. Transplants gave better results.

C. Tending—Weeding is usually necessary for the first two or even three years, cleaning being done at the same times. This latter operation should be carroid out as often as fund permit to keep down creepers, which rapidly invade the crop and tend to suppress it, especially in the damper localities such as Puri. If creepers are not removed, the young saplings become strangled, crooked and branchy. The time for the first thinning will naturally depend on the rate of growth but generally becomes necessary between the seventh and tenth years. The first thinnings should be light and should be followed about five years later by the second thinning. The frequency of thinnings will sometimes have to be limited by financial considerations. In I and II quality crops, thinnings should be repeated about every ten years from the age of 15 up to age 45, after which further thinning will depend entirely on the merits of each individual crop. The last thinning should be heavy and of the nature of an increment felling . In III quality crops thinning should be less frequent.

The following technique has been employed with considerable success in Angul and Nayagarh and is recommended for adoption.

Nursery work - Seed should be obtained from Puri Division. This is to be preferred, as it is largely produced by acclimatised trees originally grown from Burma seed. Regular nurseries will not be maintained; but seedlings will be raised by the *rab* method as follows : —

(*a*) One acre of miscellaneous forest will be clear felled in December or January and left to dry. When perfectly dry about the end of March or early April, it should be burnt. The firecer and more complete the "burnt" the better will the result be.

(*b*) After burning the stumps should be grubbed up and the area ploughed, about the end of April, or early May.

(*c*) Teak seeds should be procured by the end of March. It should be kept in bags alternately soaked in water and placed in the sun for periods of 24 hours at stretch from 7th April.

(*d*) This seed will be sown in the *rab* nursery during the first week of May. The seeds should be sown in lines 12 inches apart and 12 inches aparts in the lines. Three seeds should be sown together.

(*e*) No watering will be done.

(*f*) One acre of *rab* nursery will give sufficient stumps in the following year for planting up about 50 acres.

(*g*) Weeding will be done in June and again at the end of August.

Planting—By May the follwing year most of the teak seedlings will have reached a size suitable for "stumping". The following method of planting up the selected area will be adhered to.

(*a*) The area to be planted up will be clear felled in December or. January and burnt at the end of the March or early April, as was done in the case of the *rab* nursery. The importance of a complete "burn" is emphasised.

(*b*) In the third week of May the stumps should be prepared and put out 9′×9′ in the plantation area.

(*c*) Great attention must be paid to the preparation of stumps, as much depends on their size and the manner in which they are prepared. Stumps should be about one inch in diameter and in any case, not less than the thinkness of a thumb. Smaller plants should be kept in the nursery till the following year, as they will not give good results if used when small.

(*d*) "Stumps" or root-and-shoot "cuttings" should be cut just above the "collar" (not more than half an inch above it) and should have a root of about 9 inches long. All side shoots be trimmed off.

The stumps should be planted immediately after a shower *during the third week of May*, and under no circumstances later than 7th June. Much time and labour can be saved by using a crowbar for preparing planting holes. A further saving can be made by omitting the customary "staking out". This is not essential. The lining out can be done by means of a rope with pieces of coloured cloth tied at interval of 9 feet.

Three Weedings are essential during the first year, if the best results are to be obtained. The first should be made at the end of July, the second at the end of August and the third in September

Uses—Teak is by far the most important tree in India and is possibly the most generally useful timber adapted to a variety of purposes and available in large quantities in the world. It is used for a great number of purpose such as ship-building, beams for house-construction, bridges and other heavy work, railway carriages, wagons, carts, wheels, furniture, cabinet work, and numerous other purposes. It is exported in large quantities from Burma to Europe.

The timber is dark golden-yellow when fresh, turning golden-brown with age, oily and having a characteristic adour. The wood is moderately hard, heavy, strong and exceedingly durable, It works easily, seasons well and does not split or warp. It takes a good polish and has a good appearance. It is not attacked by white-ants.

In Bihar and Orissa the supplies of this valuable tree are limited but should be extended by plantations. Most of the teak required in Patna State for the Public Works Department was supplied from the teak-bearing areas of that State. The new Raipur-Vizianagram Railway runs close to these teak forests which will now be developed along silvicultural lines. In Puri the plantations are not in a position to supply large timber but poles from the Chandka plantation find already sale in Cuttack. These plantations have a very promising future and are being extended.

113. VITEX PEDUNCULARIS

Local names—Churai-guri, mado-chulia (Oriya) ; **Chorai** ; manjur-garhwa (Hindi) ; simijanga (Ho) ; mara-kata, bhadu (Santali).

General description—A moderate-sized or small evergreen tree, attaining 3 feet in girth and occasionally more, with light-brown smooth bark. Blaze, light yellow or cream, sometimes streaked with brown, turning darker on exposure. Young trees have a green chlorophyll layer at the surface. Leaves, trifoliate, with slender lanceolate leaflets, 3″—7″ long and a winged petiole about 2″—3′′ long; the wings being sometimes absent in old plants. Flowers, small, white, in panicles 6″—11″ long, appearing in April—May The fruit is a small avoid berry about ½″ long, which ripens in August-September.

Distribution and habitat—The tree is found throughout Orissa. It is most frequently seen in moist shady localities, often in *sal* forests and attains its best growth on cool northerl aspects. It is distinctly common in the south of Angul district and the adjoining districts.

The tree bears moderate shade and coppices well. The growth is moderately fast.

Uses—The wood is reddish-grey, hard, heavy and close-grained being scarce and usually of small size the timber is not often utilized but it is said to be used for house-posts and yokes.

The leaves and bark are used as a cure for fever and were thoug to be a cure for black-water fever, but this is now considered doubtful

Vitex negundo—(Nirgundi, begunia, *Oriya*; Shivari, Sambhalu, *Hndi*; Sursing, Bigana, *Ho* ; Puri, *Mundari* ; Sirdware, *Santal i*: 6ishinda, *Bengali*). A large strongly-scented, evergreen shrub, 1—12 ft. high, with compound leaves, having 3—5 leafets and small white or mauve flowers in panicles 2″—8″ long. The fruit is a small globose berry. It flowers during most of the year.

Very common in dedges and waste land throughout the province but not in forests. It produces, root-suckers and grows readily from cuttings. It should be useful for reafforesting waste land as it is hardy and not damaged by cattle or goats. The roots, leaves and fruits are used medicinally.

114. GMELINA ARBOREA

Local names—Gamabhari (Oriya) ; gambar (Hindi) ; kas mar (Ho, Santali) ; gumna (Kondh).

General description—A moderate-sized or large deciduous tree with pale grey bark exfoliating in white patches. The bole which is rarely straight, attains a girth of 5—6 ft. Blaze, thick chlorophyll layer under outer bark, then pale yellow, and white on the wood. Leaves, cordate, 4—9″ long, by 3″—8″ broad., shining, green above, greyish, beneath, with petioles 2″—6″ long. Flowers, yellow and brown, 1′—1½″ long, in lateral and terminal panicles. Fruit an avoid berry, yellow when ripe, with a hard bony stone. The tree flowers in February —April and the fruit ripens in May-June. It is said that the tree attains a height of 100 feet and a girth of 15 feet under the most favourable conditions, but trees of these dimensions have not been seen by the writer. It rarely exceeds, 60 ft. in height or 6 ft. in girth in this province. The seedling has toothed leaves.

Distribution and habitat—Throughout the province, although nowhere a common tree. It reaches its largest size in cool, moist localities on deep loamy, well-drained soil, although it is found growing in dry positions, where it remains stunted. It is found in both *sal* and mixed deciduous forest, being some what more abundant in the latter. It will not thrive on heavy clay, badly-drained or very sandy soil.

Silvicultural characteristics—The tree is a decided light-demander. It is intolerant of shade, and the fact that the seedlings are destroyed by animals probably accounts for the scarcity of this tree. It is moderately frost-hardy but does not stand much drought, although seedlings resist drought fairly well. Seedlings and saplings cannot survive in plantations unless protected against deer. *Gamhar* coppices extremely well and produces root-suckers. The stump gives a large number of coppice shoots which grow very rapidly.

Reproduction— Natural reproduction in the forest is scarce, due it is presumed to the lack of suitable conditions, for the seed usually germinates well. The tree can be raised without difficulty by direct sowings or by transplanting from the nursery. Root-and-shoot cuttings do equally well. Seedlings should be transplanted when a months old, and root-and-shoot cuttings after one year. This is very easy to propagate, *but without strong fencing against animals all attempts to regenerate it artificially may be abandoned.* The rate of growth is very fast, a height of 25 ft. being reached in 5-6 years under normal conditions. Coppice shoots do not appear to be so liable to damage by browsing as seedlings.

Uses—The wood is yellowish or greyish-white, soft to moderately hard, light, strong and even-grained. It seasons well, works easily and does not warp or crack. Owing to the combination of strength and lightness it is a very serviceable wood for numerous purposes, especially furniture, planking, boxes, etc. Owing to its resonance it is used locally for making drums and cow-bells. It is in good demand and would probably repay planation. At least it should be encouraged and favoured in natural crops.

The fruits are eaten by cattle and deer and are said to be used medicinally.

LAURACAE

115. ACTINODAPHNE ANGUSTIFOLIA

Local names—Sabalia, jharjhampa, tengeda (Oriya)

General description—A moderate-sized evergreen tree but more generally seen as a large shrub with thick, shiny, lanceolate leaves 4– 10″ long, glaucous (greyish) beneath in whorls. Flowers, small ; female flowers in clusters in the axils of fallen bud scales, appearing in February in Orissa. Fruit a small globose berry ripening from November to May. The bark is smooth and light brown in colour. The tree rearely attains a girth of about 3 feet in Puri and a height of 30 feet.

Distribution and habitat—In damp cool valleys under the shade of dense high forest (usually *sal* mixed with evergreen species), throughout the province but very rare except in Puri ; abundant in the Mals, especially in the high valley near Bhainsgot in Tamna block, where it is a seroious hindrance to sal regeneration. Also seen along the Aunlinadi in Angul and Rairakhol and in some of the deep moist valleys of Mayurbhanj and Bonai. It is not found in dry forests and is scarce except in the very damp type found in Puri.

Uses—The timber is light-brown in colour, moderately hard, heavy and even-grained. It is not used being small and scarce.

116. LITSAEA SEBIFERA

Local names—Baghaori, jaisanda, besond, baghtal (Oriya); medh, menda (Hindi); porja (Mundari); paruhi (Bengali).

General description—A small or medium-sized evergreen tree with grey, smooth, corky bark and a soft, yellow-brown or dirty white blaze. It occasionally attains 4 feet in girth. The leaves have an aromatic smell ; they are very variable in shape but are usually lanceolate. Flowers, small yellow, appearing in June and July. The fruit is small, globose and about ½″ in diameter ; it ripens from September to November.

Distribution and habitat—The tree is widely distributed throughout the province but is now here abundant. It is usually found in valleys and moist localities, occurring rather commonly in sal forest.

The tree is a shade-bearer and grows rather rapidly from coppice more rapidly than sal up to about 16 years of age when the sal passes it.

Uses—The wood is greysish-brown, moderately hard, fairly heavy close-end and even-grained. It is durable and takes a good polish. It is little used owing to its small size. The bark is used medicinally.

ULMACEAE

117. HOLOPTELIA INTEGRIFOLIA

Local names—Daurango (Oriya) ; charha, charora (Santali)

General description—A large deciduous tree with spreading branches and fairly smooth grey bark, having a cream-coloured blaze streaked with brown. It frequently attains a girth of 7 ft. leaves, ellipatic or ovate, 2″—4½″ long and shining. Flowers, small and green, appearing when the tree is leafless in March-April. The winged fruits are about 1″ long and hang in clusters repening at the end of May when the tree is in full leaf. The freshly cut bark and the leaves, when crushed, have an unpleasant smell.

Distribution and habitat—The tree is rather local in its distribution, occurring on the banks of rivers, commonly in moist or dry type mixed forest. The seeds yeild an oil which is suitable for the manufacture of soaps for use in sea-water. Most frequent along rivers in Orissa ; Angul, Narsinghpur, Daspalla, Athmallik, etc., but nowhere very abundant. Is not a typical tree of sal forests and is rarely found in them.

Silvicultural characteristics—The tree is a moderate light-demander. It requires very porous, well-drained soils and will not grow satisfactorily on stiff clays. It has a spreading root system. It suffers badly from forst (especially the seedlings) but is moderately tolerant of drought, although seedlings may be killed by it. The leaves are not eaten by cattle or goats. The tree coppices fairly well. The rate of growth of seedlings is fast.

Reproduction—Natural reproduction is not generally abundant but the tree can be raised easily under artificial conditions either by direct sowing or by transplanting. The seed should be sown soon after collection. The soil should be light and kept well loosened ; weeding is important. It is advantageous to water the seedlings and to shade the beds during the heat of the day in order to prevent injury from drought until the rains break.

Uses—The wood is yellowish, moderately hard, not very heavy, strong and seasons easily. It is surprising that the timber is not more used for planking, furniture, toys and turnery for which it is suitable. It is probably not very durable if exposed to the weather

118. TREMA ORIENTALIS

Local names—Kharkhas (Oriya) ; Roronga (Ho) ; Jhawar (Santali).

General description—A small evergreen tree generally less than 35ft. high with spreading branches and a thin, smooth, greyish-green bark. It occasionally reaches a height of 50 ft. and a girth of 4-5 ft.. The blaze is deep red, streaked. The leaves are ovate-lanceolate, 3″—6″ long, with an oblique base and usually covered beneath with fine silky hairs. Flowers, small, greenish, in cymes. The tree flowers in April-May and the very small yellow berries ripen from December to May. The tree grows very rapidly but does not live very long.

Distribution and habitat—Scarce in Orissa where it occurs chiefly in damp localities. It is fairly common in the open parts of Arang block, Puri, together with a heavy growth of grass and shrubs in a coppiced area. It tends to spring up in forest clearings, especially in damp localities.

Uses—The wood is pale reddish-grey, very soft, light and not at all durable. It is said to make a good gunpowder charcoal, and the bark yeilds a fibre.

MORACEÆ

119. STREBLUS ASPER

Local names—Sahara (Oriya) ; sora (Hindi) ; sahara (Santali); so : or (Ho) ; sukri-saijang, lara-saijang, ripi-chum, ote (Mundari, Ho, etc).

General description—A small branchy, evergreen tree with stiff, rough, obovate leaves 2″—4″ long. Bark, very pale grey, rather rough; blaze with thin chloraphyll layer, then white, darkening towards the wood, with a small amount of white juice (latex). The flowers are small and appear in March-April ; the fruit is a small yellow berry which ripens in May-June.

Distribution and habitat—Fairly common in all districts along the Mahanadi river; more frequent to the east of Angul. The tree is generally found at no great distance from the river on level ground or low hills and is absent from the hilly forest tracts remote from the river. It is bound elsewhere throughout the province but not so commonly and generally occurs close to water courses in open land or scrub.

The tree is much damaged by goats, and as a result is frequently only a bush. It is common in this form in the "protected forests" of Puri, towards Cuttack, in Dompara Estate (Cuttack) and in scrub jungle along the Mahanadi. It coppics well.

Uses—The timber is white, moderately hard, very tough and fairly durable. The wood is usually twisted and is not much used except as fuel, for which purpose it is good. The leaves are used for polishing wood and ivory.

120. ARTOCARPUS INTEGRIFOLIA

Local names—Panas (Oriya); kathal (Hindi) ; kanthar (Ho, Mundari, Santali) ; pudusi, The Jack Fruit.

General description—A large, handsome, evergreen tree with a wide spreading crown, a short thick trunk and dark green coriaceous, shining leaves. The bark is thick, dark-brown and rough, having a pinkish blaze streaked with white and excluding a milky juice. The leaves are elliptic and some 4″—8″ long. The flowers are greenish-yellow and numerous ; the males on cylindrical receptacles 2″—6″ long and the females on avoid-oblong receptacles over 12″ long. The flowering season is December to February and the fruits ripen from early July throughout the rainy season. The receptacles project from the trunk and large branches. The fruits are very large weighing sometimes as much as 60—80 lbs. They contain numerous seeds about 1″ long in a yellow pulp.

The tree attains large dimensions but when grown in the open branches low. A tree measured in Malyagiri block, Pal-Lahara, had a girth of 11 ft. at breast-height and a straight bole measuring about 50 ft. to the first branches and about 90 ft. in total height. This tree is in dense high forest of a damp type.

Distribution and habitat– The tree is a native of the Western Ghats, south of Bombay, but is cultivated widely throughout our area. It seems to thrive best on cool uplands with a heavy rainfall, such as the high tablelands in Bonai, Keonjhar, Mayurbhanj and Pal-Lahara. It is frequently planted as a shade tree along roads, for which purpose it has hardly an equal since it serves the dual purpose of providing shade and fruit. Moreover, the timber is of good quality.

Silvicultural characteristics—The tree will stand considerable shade but will develop under full sunlight. It is very frost-tender. It coppices well. Elephants are very partial to the fruits and trees must be protected against them in Orissa.

The tree can easily be raised by direct sowings but it is difficult to transplant owing to its long tap-root. Seed must be sown at once at the commencement of the rains since it loses its vitality very rapidly. Seedlings should be watered regularly and benefit from shade. The growth is slow at first but more rapid after the first two or three years.

Uses— The wood is yellow, becoming orange-coloured on exposure. It is fairly hard, strong, not very heavy, and is considered to be of good quality. Trees are only felled when diseased or dead on account of the value of their fruit. However, the timber is used for drums, furniture and other purposes. The fruit is extensively eaten and the seeds are also cooked and eaten.

Artocarpus lakoocha—(Jeonta, *Oriya* ; lolai, Kondh daho, dohu, Ho, *Santali* ; denyo, barhal *Hindi*). A large, evergreen tree, very like the last in general appearance. The leaves are larger, more obtusely ovate, 6″—12″ long. The fruit is small and yellow, 3″-4″ in diameter, but not unlike a very small jack-fruit. It is rather a rare tree but occurs scattered, generally at high elevations or in cooll moist localities throughout the province. The Bhuinya plateau of Bonai ; Keonjhar and Pal-Lahara ; on the Kuldiha plateau, Nilgiri in the Simlipal Hills of Mayurbhanj. Not seen by the writer south of the Mahanadi, but is said to occur in the Mals of Puri and may be found in South Kalahandi. It is not found on the hot dry plains of west Orissa. The timber is said to be excellent but is not known to be used in the province. It is sometimes planted as a roadside tree. The fruit is eaten.

121. FICUS RELIGIOSA

Local names— Ososto (Oriya) : aswattha (Sanskrit) ; pipal pipar (Hindi) ; tepe-hesa (Ho, etc.) ; hesak' (Santali) pippala (Kondh).

General description—A large spreading tree with a short thick trunk and an extensive crown. Almost evergreen. Epiphytic when young, i.e., growing upon other trees, walls, etc. Bark, grey, smooth, and often pitted when old. It exudes a milky juice when cut leaves, broadly ovate with a cordate base and a slender tail (1 —3″). long, dark green and shining above; total length 5—7″. Petiole 3-4″ long. The young leaves are usually reddish. Receptacles globose, fleshy, about ½″ in diameter and dark purple or black when ripe. It fruits in the rainy season. A very well-known tree.

Distribution and habitat—Commonly planted and wild throughout the province. It is easily raised from seeds or cuttings and grows rapidly. It is a very hardy tree and stands drought and frost well. It is difficult to kill by girdling. In the forest it is a pest but fortunately is not usually abundant there. The fruits are eaten by birds and animals, especially green pigeons, and the seed is spread in this way. The branches are lopped for elephant fodder. The tree is commonly planted along road sides and avenues. It does not coppice.

The wood is moderately hard but little used. It is a sacred tree of the Hindus, who have a prejudice against felling it. Lac can be grown on it but is of rather inferior quality. The tree is very destructive to walls and masonry.

122. FICUS BENGALENSIS

Local names—Boro, bor (Oriya-Bengali) ; barh (Hindi) ; bare (Mundari, Santali) ; ba : i (Ho) bondang (Kondh) ; the Banyan tree.

General description—A very large spreading, shady evergreen tree with numerous aerial roots hanging down from the horizontal branches. The bole is short, often of immense girth, very irregular and deeply grooved in old trees. Bark grey, fairly smooth; blaze, pale red, fibrous—exuding a milky juice. The aerial roots grow from the branches and take root in the ground (unless continuously eaten by animals and thus kept in check), forming numerous fresh stems. If protected, these increase in number until the tree appears like a vast conopy supported on numerous pillars and may cover a large area of ground. The crown-spread has on occasions a diameter of 200 feet or more. The leaves are ovate or elliptic, coriaceous, dark green and shiny above, 4—8″ long and sometimes more. In dry localities they are shed. They are renewed in May-June. The receptacles are globose and fleshy, about ½″—¾″ in diameter occurring in pairs. They turn scarlet when ripe : chiefly from April to June and again from December to February. The tree is often epiphytic.

Distribution and habitat—Throughout the forests of the province generally in moist localities. Frequently planted as a shade tree, for which purpose it is perhaps unequalled. It is commonly found near camping grounds, in villages and along roads. The fruits are largely eaten by birds and animals, especially green pigeons, *mainas*, fruit bats and monkeys. The seed is spread by their agency and frequently germinates in the forks of other trees where it becomes epiphytic and eventually kills the host tree. It damages masonry in the same way as *Pipal*. It grows readily from seeds or cuttings. Large cuttings 8—10 ft. high may be used and should be planted from January to March and kept well watered until the rains. It does not coppice and is very difficult to kill by girdling.

Uses—The timber is grey in colour and moderately hard. It is not much used. It is not durable except under water and is sometimes used for well-cubs. The branches and leaves are lopped for elephant fodder. Bird-lime is prepared from the sticky juice (latex).

123. FICUS CUNIA

Local names—Purhai, potkuli, (Oriya); bhoka-dumbar (Bengali) ; podho, ari (Mundari) ; A i (Ho) ; hor-podo (Santali) ; dohi, dosi, pode (Kondh).

General description—A small or moderate-sized, usually evergreen tree with thick, reddish-brown, rough bark and having numerous recepts (fruits) in masses on drooping branches several feet long. Leaves, rough, 6—15″ long, oblong-lanceolate, entire or serrate, having a semi-saggitate base and a short petiole. The receptacles are globose or pear-shaped, reddish brown or white when ripe, and about ½″ in diameter. They ripen in May-June. The tree is not epiphytic.

Distribution and habitat—In forest tracts throughout the province in cool, damp localities usually near streams. The tree is not very common anywhere. Lac is cultivated on the branches in Singhbhum and the fruits are eaten. The wood is greyish-brown and moderately hard. It is not used. The leaves are rough and are said to be used as sandpaper.

124. FICUS GLOMERATA

Local names—Dumri, dimri (Oriya) ; dumar, gular (Hindi) ; loa (Mundari, etc.). tain, taya, thoaga (Kondh).

General description—A moderate-sized or large, usually deciduous tree with a spreading crown and a short bole often exceeding 5 ft. in girth. Bark, pale greenish-grey ("reddish-brown" according to Troup and Gamble), smooth and usually marked with scars. Leaves, ovate-lanceolate or elliptic, 4″—8½″ long by 2″-3″ broad with rather distinct veins. The receptacles are 1″-2″ in diameter, globose or pear-shapped, in clusters on the trunk or along the branches. They ripen from March—June and turn red when ripe. The tree is sometimes deciduous in October-November.

Distribution and habitat -In cool, damp localities throughout the province but not very abundant. The tree is commonly planted near villages for its fruit, which is largely eaten, and for lac cultivation. The leaves are lopped for cattle and elephant fodder. The wood is greyish-brown and soft. It is not durable and is seldom, if ever, used. The milky juice is used for bird-lime.

The tree coppices and can be grown readily from seed or cuttings. It is difficult to kill by girdling.

Ficus infectoria—(Kua-jari, *Oriya* ; paker, *Hindi* ; barsahesa, jojo-hesa, *Ho;* jadi mara, *Kondh*). A large tree much resemlbing pipal in general appearance but differeing slightly in the shape of the leaves. Fairly common in Orissa.

SALICACEÆ

125. SALIX TETRASPERMA

Local names—Garasigric (Santali) ; nachal (Ho) ; bes (Hindi).

General description—A small deciduous tree with a short bole, sometimes attaining 4ft. in girth (Kalahandi) and deeply fissured, dark-brown, rough bark. The shoots are covered in soft silky hairs. Leaves narrow, lanceolate, 3″—5″ long, pale beneath. The catkins on the short lateral shoots are 1½″—4″ long and appear in October. It fruits shortly afterwards.

Distribution and habitat—Rare except in the higher hills above 2,500 feet. Occasional along the Karo in N. Keonjhar and Kuradi in Bonai, abundant along the Indravati and some of its larger feeders in Kasipur 2,500—3,000 ft. Kalahandi.

The tree grows well from cuttings in damp places. It coppices and pollards well. It is frost-hardy but suffers from drought. The rate of growth is very rapid.

Uses—The wood is reddish-brown in colour, soft and even-grained. It is not much used in our area but is suitable for planks. It has been tried for making cricket bats but is not sufficiently soft. The twigs are used for basket-making and the leaves for cattle fodder.

CASUARINACEÆ

126. CASUARINA EQUISETIFOLIA

Local names—Jamu (Oriya); bilaiti jhau (Bengali).

General description—A large evergreen tree with drooping branches and dark green, feathery foliage. The bark is rough, fibrous and exfoliates in long strips. Under favourable conditions the tree attains a height of 100—130 ft. and a girth of 6-7 ft. but, these dimensions have not been seen in our province, where a height of 80 ft. is rarely exceeded. The tree bears a superficial resemblance to a conifer. The scale-like leaves are borne in whorls of 6—8 on very slender branchlets. The male and female flowers are borne separately: the male spikes being borne at the ends of the branches and the female flowers lower down on the same branch. The tree usually flowers twice in the year, from February to April and from September to October. The fruits are globose woody cones, about ¾″ in diameter, containing a number of winged seeds. They ripen irreguarly from June onwards to December, the chief season in Puri being December. The tree is short-lived and rarely survives more than 50 years. In unfavourable localities the limit may be placed at 25—30 years. The jointed branchlets are partly deciduous and litter the ground to a depth of a couple of inches in plantations.

Distribution and habitat—This tree does not occur naturally in Bihar and Orissa but has been extensively planted in the coastal districts of Orissa in gardens and as a road side tree. A plantation of about 4,000 acres has been made on the sands close to Puri with the object of supplying the town with firewood. The tree is occasionally met with planted inland, in Angul, Sundargarh, Sambalpur and elsewhere but it does not thrive far from the coast.

The tree grows best on pure sand or on light sandy soil but soon dies off on badly-drained ground. A plantation of some extent was started in 1930 at Anandpur in Keonjhar State, on alluvial land that had been covered by sand as a result of the flooding of the Baitarani in 1927. The results to date are not very promising and it has been abandoned in favour of *sissu*, which has proved most successful. It has, however, done well where planted pure and not in mixture with the sissoo.

Silvicultural characteristics—The tree is a decided light demander and will not tolerate shade. It is moderately resistant of drought but the seedings are tender in this respect and require watering until established. *Casuarina* is extremely susceptible to damage by fire and is killed outright. The tree does not coppice well but several stumps have produced shoots in Puri when cut farely high; what the subsequent growth will be like remains to be seen. Root-suckers are also said to be produced but these are not very evident in the Puri plantation. The rate of growth is very fast.

The tree is liable to certain diseases and insect pests, chief amongst which is *Arbela tetraonis*, the bark-eating caterpillar Young plants have their roots damaged by the rhinoceros beetle *Oryctes rhinoceros*, and seedlings are subject to attack by crickets such as *Brachytrypes achatinus*. Serious mortality is caused by a root fungus, *Trichosporium vesiculosum*.

Reproduction— Seed is produced in abundance but natura seedlings are absent. This is probably due to lack of moisture between the time of seed fall in December and the monsoon in June. Insects are also responsible for damage to the seeds.

Artificial regeneration is not difficult, the following being the procedure followed in Puri. The seeds are sown broadcast in the nursery in January and watered. After six weeks the seedlings are lifted and transferred to bottomless earthenware pots where they remain till the monsoon, being watered regularly. The plants are then removed from the pots and planted out in pits 3 ft. by 3 ft. Care is taken to water the plants throughout the ensuing cold and hot weather until the break of the second monsoon. The cost of formation in Puri (exclusive of the cost of the land which was about Rs. 25 per acre) varied somewhat, the average being between Rs. 8 and Rs. 9.

The nursery beds are raised and composed of sandy soil mixed with cowdung.

Uses—The wood is reddish-brown, hard and cross-grained. It cracks and splits easily. It is only used as fuel, for which purpose the tree is very suitable owing to its quick growth and the very short rotation on which it can be worked. The most usual rotation is about 12—15 years, but is sometimes shorter.

FAMILY: CONIFERÆ

127. PINUS LONGIFOLIA

One of the characteristics of the *chir* pine is the local occurrence of "twisted fibre", which means that the fibres of the wood instead of being straight are spirally twisted. This detracts greatly from the value of the timber. Both right-handed and left-handed twist occur. It is not known, if "twist" is prevalent in the Sameshwar hills. It appears fairly certain that seed from "twisted" tree will produce "twisted" offspring. Hence, the source of seed for plantation purposes should be carefully investigated.

The rate of growth is moderately fast: about 4″ in the first season and 5 ft. after five years.

Reproduction— No data is available regarding the state of regeneration in the pine forests of Champaran. Generally speaking, however, the seed germinates readily and its survival is largely a matter of sufficient light and moisture combined with absence of fire and goats.

Artificial regeneration is best carried out by direct sowing, since transplants rarely meet with success unless the work is executed with extreme care. Direct sowings, however, are easy and give excellent results. The seeds should be coated with red lead before sowing to prevent damage by insects and other pests. The seed should be sown at the break of the rains, or earlier, if watering can be done. The seedlings require very little attention apart from slight protection against drought, which can be given by a light covering of grass. *Chir* does exceptionally well, if sown on a hill-slope among ashes. Hence, it might be useful for clothing *jhumed* areas in the Bonai and Keonjhar hills. It is also a good species for sowing in frost-hollows in our area.

Uses—The heartwood is light reddish-brown, moderately hard with conspicuous resin ducts, light and fairly strong. It works easily and seasons readily. It has been heavily exploited in the Sameshwar hills. It is used for buildings, rough furniture, boxes and general carpentry. It is used in the Punjab and the United Provinces for sleepers after treatment with a preservative.

Chir is the principal resin-producing pine in India but it is not tapped in our province. A high grade of turpentine is prepared from the resin in factories situated in the Punjab and the United Provinces.

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